Cardio Menu

Operator Manual

SP-10 Spirometry Unit

Service Handbook

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SP-10 Service Handbook

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Associated Documents

Guide to SCHILLER Interpretation and Measurement Program E / D / F	Article No.	2. 510 179
SCHILLER SP-10 USER GUIDE - English	Article No.	2. 510 130
SCHILLER SP-10 USER GUIDE - German	Article No.	2. 510 129
SCHILLER SP-10 USER GUIDE - French	Article No.	2. 510 131
SCHILLER SP-10 USER GUIDE - USA	Article No.	2. 510 277

CE 0124 93/42/EEC Medical Devices: 0124
'Notified Body' DEKRA AG

DECLARATION OF CONFORMITY

Diagnostic System :	**Spirovit SP-10**
Serial numbers starting with:	040.
Year of manufacture:	1997 Onwards

We, the undersigned, hereby declare that the medical device (class IIa) specified above conforms with the essential requirement listed in Annex 1 of EC Directive 93/42/EEC.

This declaration is supported by:

Certificate of approval No.:	11425-01	ISO 9001 (REv. 1994) EN 46001 by SQS
	45112-60-01	ISO 9001/08.94 EN 46001 / 12.93 by DEKRA and
	45112-16-01	Annex II, Section 3 of the directive 93/42/EEC

CE 0124

Baar (Switzerland) Dated 30.06.1998

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Warranty

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The manufacturer can only be held responsible for the safety, reliability, and performance of the apparatus if:

° assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by him, and

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DO NOT USE THIS UNIT IN AREAS WHERE THERE IS ANY DANGER OF EXPLOSION OR THE PRESENCE OF FLAMMABLE GASES SUCH AS ANAESTHETIC AGENTS.

IF THE DISPLAY IS DAMAGED, A LEAKAGE OF FLUID MAY OCCUR. DO NOT INHALE THE VAPOUR FROM THIS FLUID AND AVOID CONTACT WITH MOUTH AND SKIN. IF CONTACT IS MADE, CLEAN CONTAMINATED AREA IMMEDIATELY WITH FRESH WATER.

THIS PRODUCT IS NOT DESIGNED FOR STERILE USE.

SWITCH THE UNIT OFF BEFORE CLEANING AND DISCONNECT FROM THE MAINS.

DO NOT, UNDER ANY CIRCUMSTANCES, IMMERSE THE UNIT OR CABLE ASSEMBLIES IN LIQUID.

DO NOT OPERATE THE UNIT IF THE EARTH CONNECTION IS SUSPECT OR IF THE MAINS LEAD IS DAMAGED OR SUSPECTED OF BEING DAMAGED.

DO NOT USE HIGH TEMPERATURE STERILISATION PROCESSES (SUCH AS AUTOCLAVING). DO NOT USE E-BEAM OR GAMMA RADIATION STERILISATION.

DO NOT USE SOLVENT CLEANERS

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THE SP-10 COMPLIES WITH EMC REGULATIONS FOR MEDICAL PRODUCTS WHICH AFFORDS PROTECTION AGAINST EMISSIONS AND ELECTRICAL INTERFERENCE. HOWEVER SPECIAL CARE MUST BE EXERCISED WHEN THE SP-10 IS USED WITH HIGH FREQUENCY EQUIPMENT.

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Safety Notices

WHEN OPERATING THE UNIT ON BATTERY AND SIMULTANEOUSLY USING NON.MEDICAL DEVICES, THE RS-232 INTERFACE MUST BE FULLY ISOLATED.

BEFORE USING THE UNIT, ENSURE THAT AN INTRODUCTION REGARDING THE UNIT FUNCTIONS AND THE SAFETY PRECAUTIONS HAS BEEN PROVIDED BY A SCHILLER REPRESENTATIVE.

THE GUIDELINES FOR PATIENT ELECTRODE PLACEMENT ARE PROVIDED AS ON OVERVIEW ONLY. THEY ARE NOT A SUBSTITUTE FOR MEDICAL EXPERTISE.

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IT IS THE PHYSICIANS RESPONSIBILITY TO MAKE THE DIAGNOSIS OR TO OBTAIN EXPERT OPINION ON THE RESULTS, AND TO INSTITUTE CORRECT TREATMENT IF INDICATED.

What's in this Book

THE SERVICE PHILOSOPHY FOR ALL SCHILLER UNITS IS FAULT FINDING TO MODULE LEVEL. THE PURPOSE OF THIS BOOK IS TO PROVIDE ALL THE INFORMATION NECESSARY TO ENABLE THE SERVICE ENGINEER TO EFFICIENTLY LOCATE AND REPLACE A FAULTY MODULE. THIS BOOK ASSUMES NO DETAILED KNOWLEDGE OF THE SP-10 BUT DOES REQUIRE THAT THE SERVICE ENGINEER IS FAMILIAR WITH STANDARD WORKSHOP PRACTICES.

The book is divided into the following chapters:

Chapter 1 - Operating Elements

The purpose of this chapter is to provide an easy reference for all the main operator functions and to give a basic introduction to the SP-10. This chapter gives details of the operator controls with the operation and function of each key briefly explained. The information in this chapter provides a background to the operating functions only. Complete operating information is provided in the SCHILLER SP-10 Operating Manual.

Chapter 2 - Functional Description

This chapter provides a functional overview of the SP-10 The functional description is supported by functional block diagrams.

Chapter 3 - Fault Diagnosis and Check Procedures

This chapter provides a guide to locate a fault to module level. The diagnostics are presented in a logical sequence of fault finding algorithms and procedures. Illustrations are provided to support the text where needed.

Chapter 4 - Physical Overview & Module Replacement

This chapter gives an overview of the physical construction of the SP-10 with the main physical attributes of the unit briefly described. The physical description is supported by illustrations showing the internal location of all modules. Removal and Replacement instructions for all replaceable modules are also provided in this chapter. Each procedure is autonomous with details of tools, jumper settings, adjustments, and settings or special requirements that are required before and after replacement. Functional checks that must be carried out after replacing a new module are also provided.

Chapter 5 - Spare Parts

This Chapter provides the part numbers and reordering information for all replaceable modules. Also included in this chapter are details of any special test equipment or special tools required for adjustment or fault finding procedures.

Chapter 6 - Technical Data

The full technical specification of the SP-10 is given in this chapter.

Chapter 7 - Glossary

This Chapter explains all the acronyms and signal titles used in this book and in the SP-10 circuit diagrams.

What's in this Book

Circuit Diagrams & Board Layouts

The circuit diagrams and component layouts are provided for all boards. These details are provided for information only.

We Need Your Help

The philosophy of SCHILLER is one of continuous improvement. Our aim is to provide the user with the most up-to-date information and the latest technological developments. We reserve the right to revise this document and make changes or improvements at any time.

Your suggestions and comments are welcome. Please contact the SCHILLER Technical Documentation Department:

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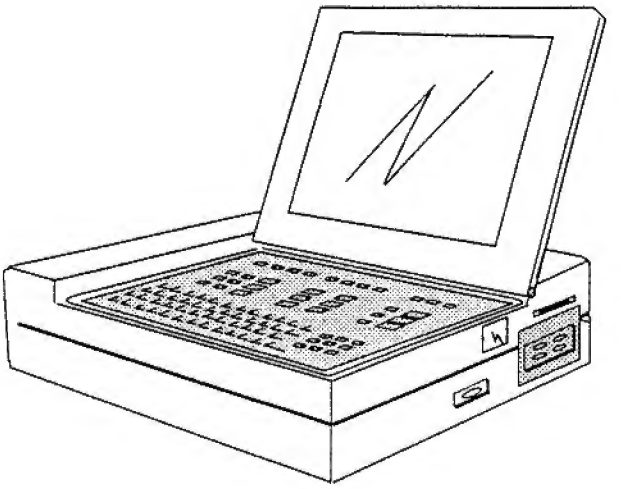
Chapter 1
Operating Elements

Contents

Introduction



The SCHILLER SPIROVIT SP-10

The SPIROVIT SP-10 is a sophisticated compact work-station for pulmonary diagnosis. It is capable of working in four measurement modes as follows:

◊ Forced Vital Capacity

◊ Vital capacity

◊ Expired or Minute Ventilation

◊ Maximum Voluntary ventilation

In addition options enable resistance testing, and blood oximetry diagnosis to be carried out.

The test results are displayed on the integral LCD and recorded on the built-in thermal printer.

The open pneumotacho transducers SP-20/SP-110/SP-150, with disposable mouthpiece, are used for respiratory measurement.

Three RS-232 interfaces and one RS-422 interface are provided for data transmission/reception. The unit also has facilities for connection of an external video monitor.

The SP-10 can also be connected to the SCHILLER PC based data management program (designated SEMA), for the validation and archiving of recorded data.

Introduction (cont.)

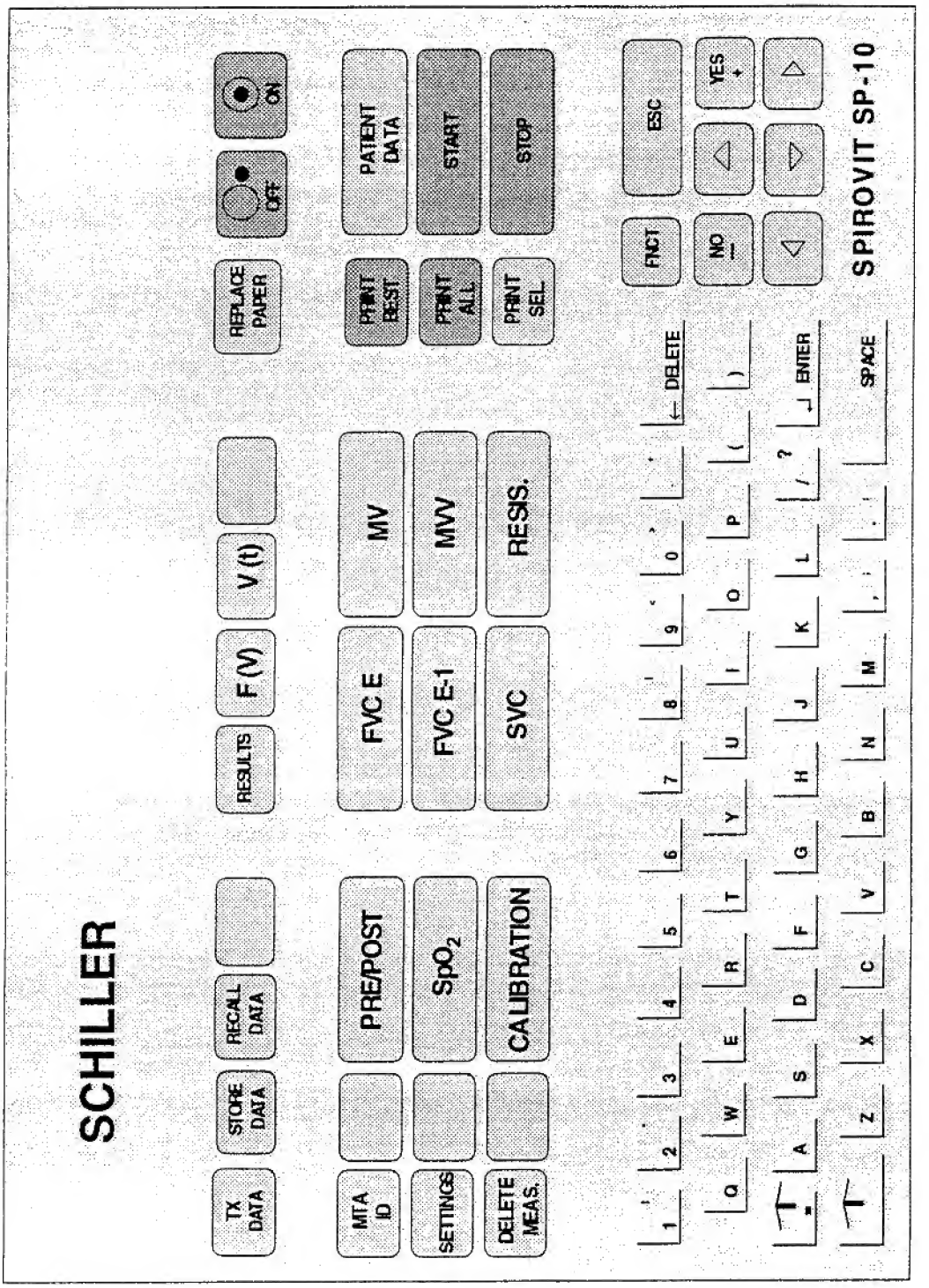
The main operating and connection modules of the SPIROVIT SP-10 are as follows:

- Keyboard — The keyboard comprises the general function and control keys, and the alpha-numeric keys for data entry.
- LCD Screen — The LCD screen displays the pulmonary traces and certain operating and status information. Under operator control the display also gives menu options and displays operator entered data. The display is folded down when not in use.
- Thermal Printer — The printer provides hard copy of test results.
- Right-hand Side Panel — The side panel contains the Spirometry connector and the RS serial connectors. When the floppy disk storage option is installed, the disk drive is installed on this side panel.
- Left-hand Side Panel — This panel contains the paper tray and (below the paper tray) the program pack.
- Rear Panel — The rear panel contains the video monitor connector and the mains connector with on/off switch, voltage selector and mains fuse.

The Keyboard

Alpha Numeric Keyboard

The alphanumeric keyboard serves as a normal keyboard for data input.

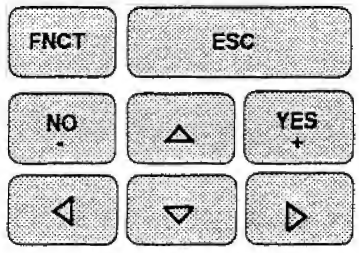


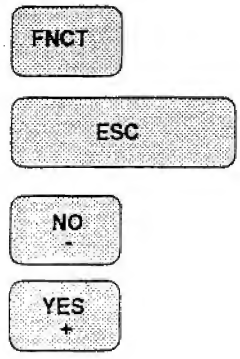
The SP-10 Keyboard

The Keyboard (cont.)

General Purpose Keys

The general purpose keys to the right of the alpha-numeric keypad, are as follows:





Call up main menu / return to Monitor mode

Return to previous menu

Change setting / disable command

Change setting / enable command

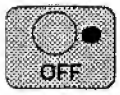
The direction keys are used to move the cursor in order to make menu selections

The Keyboard (cont.)

Control and Function Keys

The Control and function keys are situated above the alpha numeric keyboard. The control and function key are as follows:

Switches the unit on



Switches the unit off

Extend Paper Tray / Retract Paper Tray

Entry of patient data

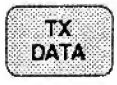
Start selected test

Stop printout / move paper to start position

Print the best test result

Print all test results

Select test result for print



Initiate data transmission

Initiate data storage

Initiate receive mode

Enter details of the Medical Assistant

Display general settings menu

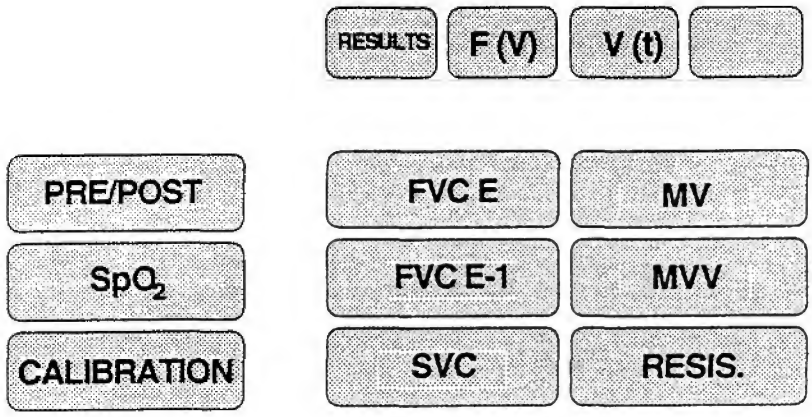
Delete stored measurment

Note: Slight functional differences may exist in different modes

The Keyboard (cont.)

Test Function Keys

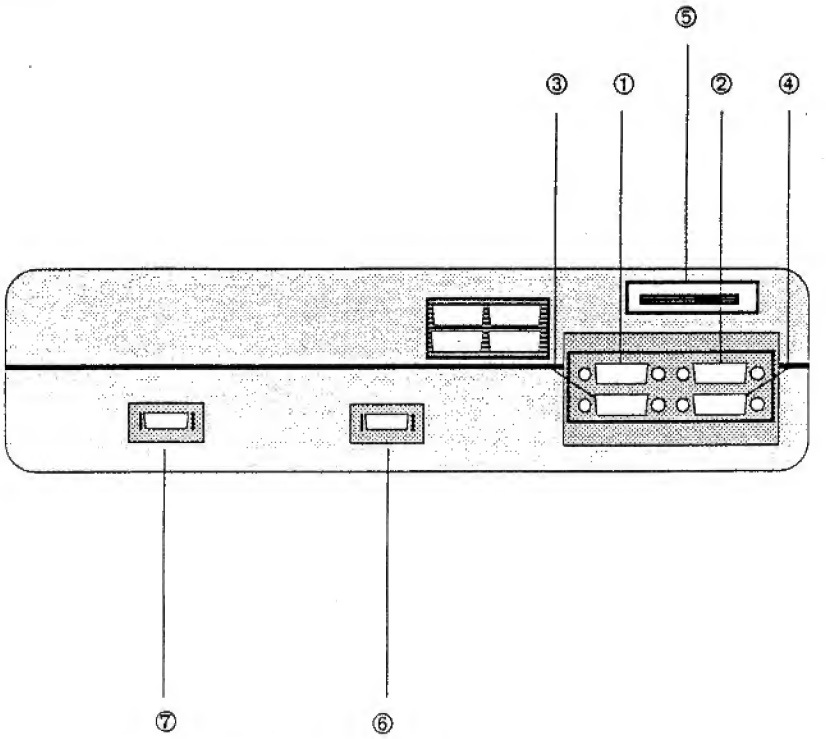
The function keys are arranged in a group in the middle of keyboard. The following is a summary of the keys and their functions:



RESULTS	Display test reults
F (V)	Flow (against Volume)
V (t)	Volume (against time)
FVC E	Forced Vital Capactity test (Exhalation only)
FVC E-1	Forced Vital Capactity test (Exhalation and Inhalation)
SVC	Vital Capacity
MV	Minute Volume (volume in one minute)
MVV	Minute Volume (forced volume in one minute)
RESIS.	Reistance test (Option)
PRE/POST	Test pre and post (medication)
SpO_2	SpO_2 test (Option)
CALIBRATION	Calibration of the unit for the environmental conditions

Connector panels

Side Panel

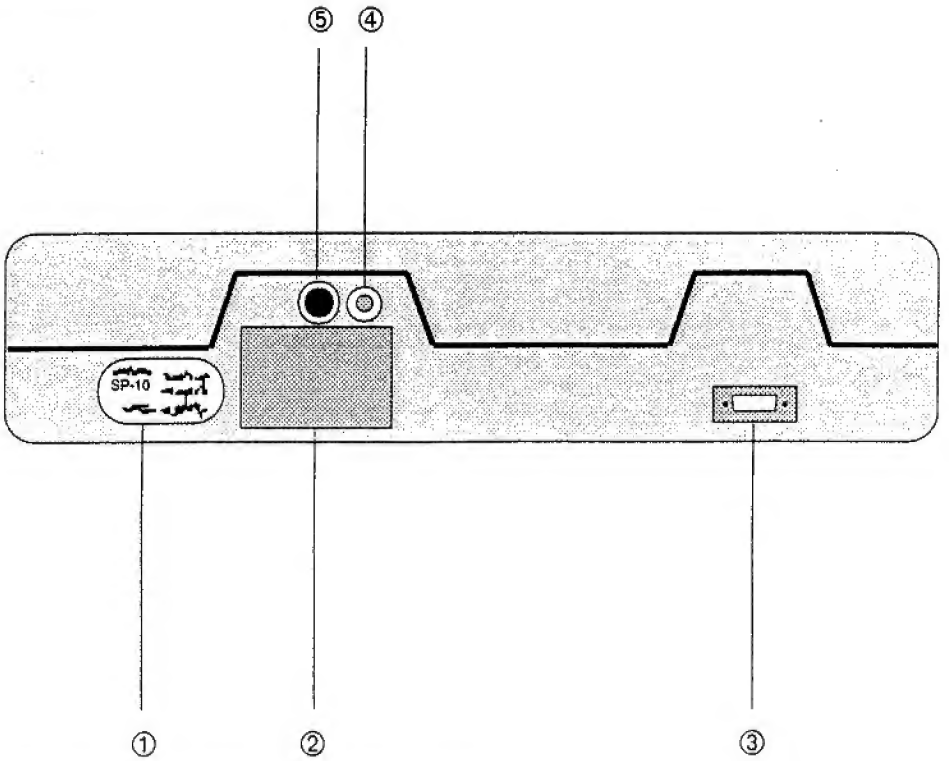


The following are located on the side panel:

1. 1 X RS-232C interface (Port 1)
2. 1 X RS-232C interface (Port 2)
3. 1 X RS-232C interface (Port 3)
4. 1 X RS-422 interface (Port 4)
5. LCD contrast control
6. Connection for SP-20, SP-110 or SP-150 flow sensor for lung function measurements (with or without resistance test facility)
7. SpO_2 connection

Connector panels (cont.)

Back Panel

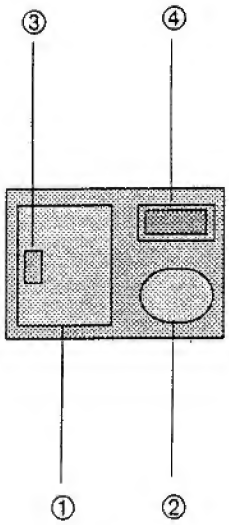


The following connectors are located on the back panel:

1. Identification Plate
2. Mains Module
3. Connector for external video
4. Potential equalisation (ground) connection
5. Local area network Connector (Option)

Connector panels (cont.)

Mains Panel



The following are located on the mains panel:

1. Mains fuse (200 mA slow) and voltage selector
2. Mains connection
3. Voltage indicator (mains)
4. Power on / off switch

Chapter 2
Functional Description

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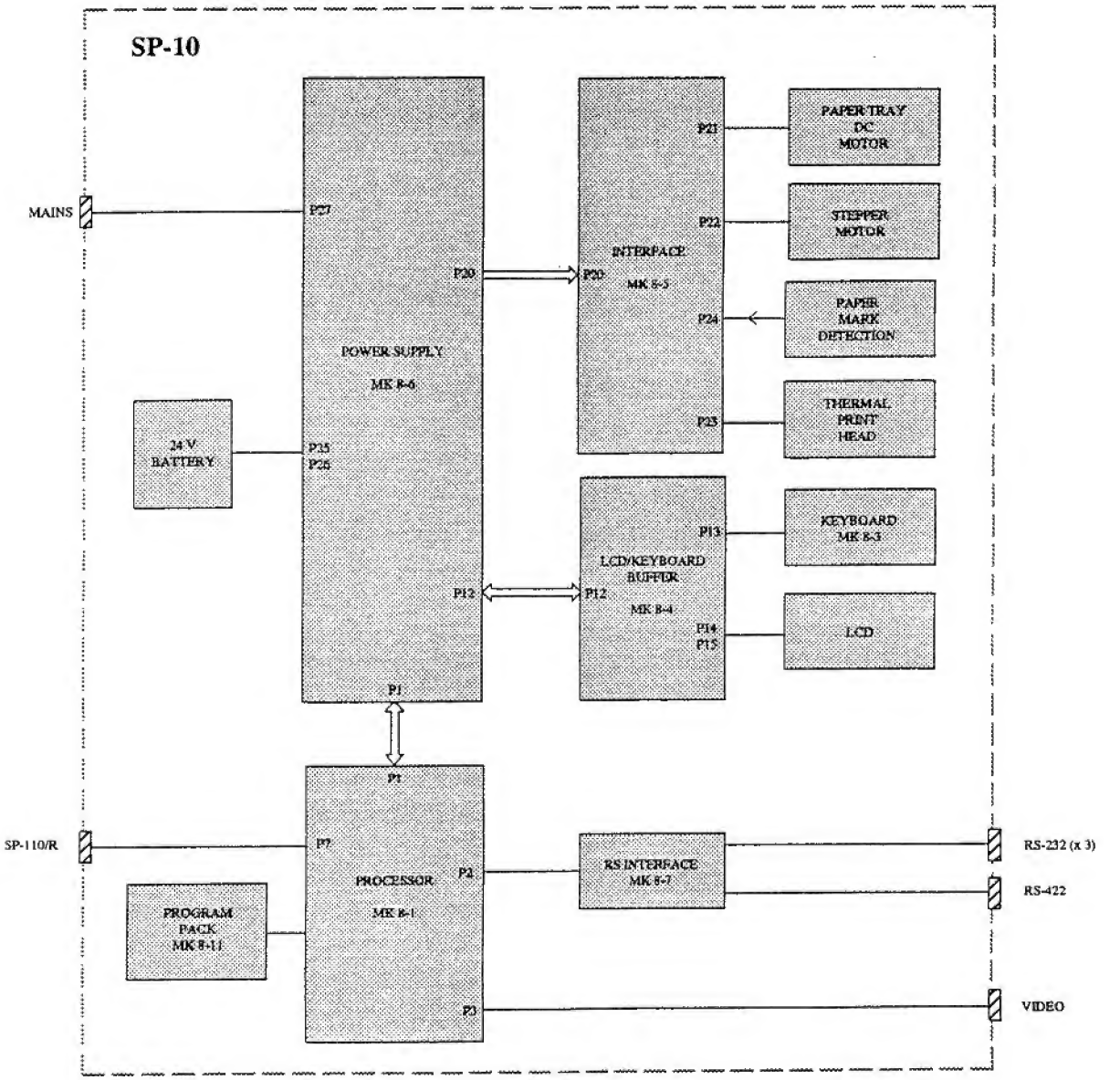


SP-10 Basic Block and Interconnection Diagram

Brief Description

The SP-10 comprises the following boards and major functional areas:

Power Supply

The power supply rectifies the mains input and generates all the required voltages for the SP-10 electronics. Two rechargeable 12V batteries, connected in series, provide the power for the printer and enable the SP-10 to operate for about 45 minutes, when mains is not present.

Processor Board

The Processor Board is the master control for all peripherals and contains the main CPU, system timing circuits and the unit RAM memory. This board also contains the following:

- Video signal generation circuits and the video/LCD conversion circuit for the LCD
- Program Pack containing the unit software
- Print control, keyboard timing, and graphics control circuits

The Processor Board communicates externally over the following connectors:

- Serial RS-232 and RS-422 interfaces for data transmission to other units or to an external computer for data evaluation and storage.
- Video connector for connection of an external monochrome VGA standard monitor. The digital video signal reflects the current LCD display.
- Spirometry connector for connection of a spirometer (SP110).

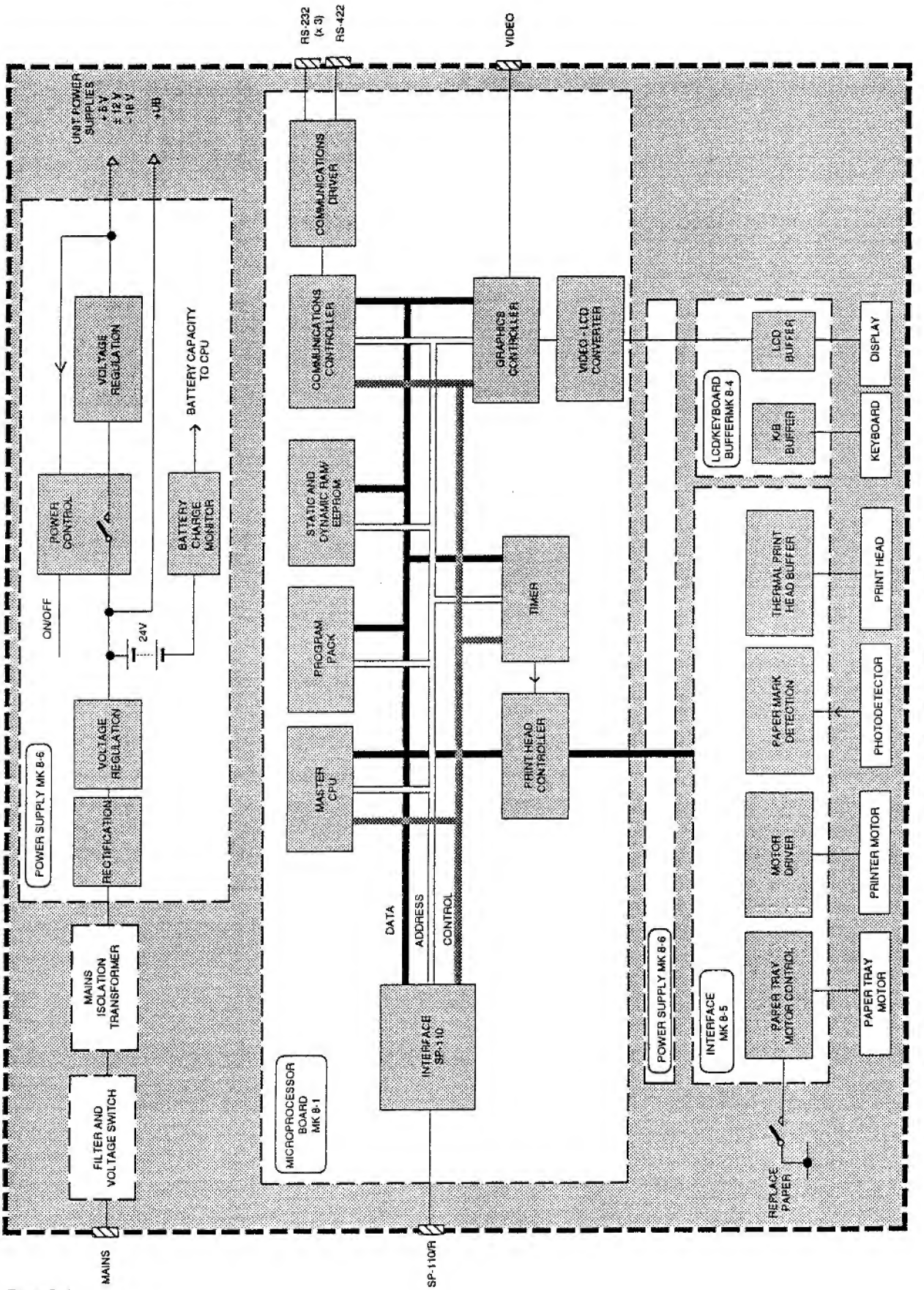
Interface Board

The Interface board contains the following:

- Paper mark detection circuit
- Thermal print head data buffers
- Stepper motor control circuit
- Control circuit for the paper tray dc motor

LCD/Keyboard Buffer Board

This board buffers the LCD and keyboard data and contains the high voltage circuit for the LCD.



SP-10 Functional Block Diagram

Overall Functional Description

Power Supply

Mains is applied to the power supply via a mains filter, on/off switch and a voltage selection switch. The voltage selection switch connects the supply to the relevant winding of the mains isolation transformer. The ac voltage is then rectified to produce a resultant dc voltage of approximately +27V. This voltage is applied to regulator circuits which generate all of the dc power supplies required by the SP-10 electronics.

The power on/off control circuit switches the supply voltage to the regulators. The power on/off is controlled by the following conditions:

- On signal from the keyboard
- Off signal from the Microprocessor (Off key pressed on keyboard, 5V supply below 4.75V)
- Overcurrent condition on the +12V rail

Two 12V batteries, connected in series, directly provide the power for the thermal printer, and provide power for the switching regulators when mains is not connected. The charge state of the battery is monitored by a battery charge monitor circuit.

Processor and Memory

The SP-10 is controlled by a high speed, CMOS 68000 processor with a 16-bit data bus and 23-bit address bus. The clock speed is 16.7 MHz. The processor works in conjunction with a dedicated gate array which is custom programmed to perform specific tasks. The working RAM memory comprises 256 kByte of static RAM and 2MByte of dynamic RAM. The dynamic RAM holds the measured data and other variables and an EEPROM holds the operator selectable parameters. The unit software comprises 256kBytes of EPROM contained on the program pack.

The keyboard is a matrix style circuit which is periodically scanned by the processor via the Keyboard Interface circuit. When a key is pressed, the key information is clocked to the processor board for interpretation by the master CPU.

Printer Control

The Thermal Print Head is controlled by the Print Head Controller circuit and the Timer circuit. The print head controller serialises the parallel data written by the CPU into a 16-bit FIFO register. The Timer circuit controls how long current is applied to the head, and thus the intensity of the print-out.

The printer motor speed is controlled by the master CPU via the Timer circuit.

Graphics Control

The display data is generated in the graphics processor circuit under the control of the master CPU. The graphics processor outputs a VGA standard serial video signal. The video signal is converted to an LCD signal by the Video - LCD circuit.

Overall Functional Description (cont.)

Miscellaneous Inputs/Outputs

Spirometry

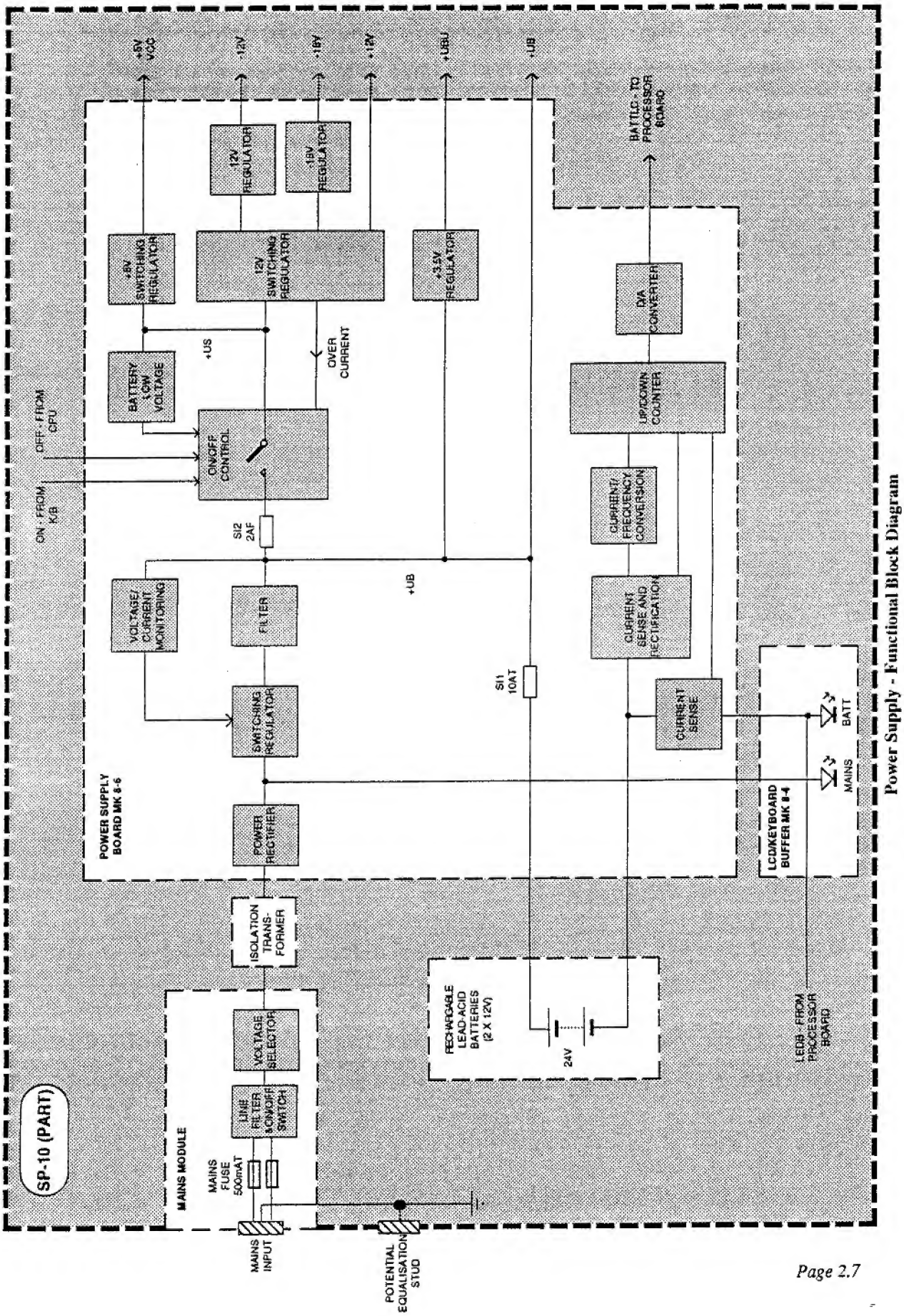
The serial input signal from the spirometer is connected to the interface circuit. The serial data is clocked into a shift register in the interface circuit and, when enabled the data is presented in parallel on the data bus for interpretation by the master CPU.

Video Connector

The video connector outputs the serial video signal generated by the graphics processor. The video connector reflects the same data as that displayed on the LCD.

Serial Ports

The Communications Controller contains USARTS which generate serial signals for the transmission and reception of data. The Communications Driver circuit contains interface circuits to ensure signal level compatibility with RS-232. The RS-422 connector is used when high data rates are required or when longer cable lengths are used.



Power Supply - Functional Block Diagram

Power Supply

Mains is applied to the line filter via the on/off switch and two 500 mA, slow-blow fuses. The line filter incorporates a temperature variable resistor to ensure that the current is limited at initial switch-on. After a few seconds the resistor warms, the resistance drops and normal power is supplied. The voltage switch ensures that the correct primary winding of the isolation transformer is used for the mains voltage applied.

The transformed ac input is full-wave rectified by a bridge rectifier to produce a dc voltage of approximately +22V. The rectified voltage is used by a switching regulator and filter circuit to generate the +UB supply .

The switching regulator comprises a pulse width regulator chip (U1) which controls a power MOS FET (Q1). The FET acts as a switch to control the current flow in loading coil T1 and thus, via diode D4 and output filter (C89, C13 etc), regulate the voltage of +UB.

The pulse width set by U1, is determined by an oscillator circuit (C8 and C9) which is controlled by the feedback on the current sense (via Q1 power FET), and the voltage feedback from +UB (via VR1). The frequency is between 40kHz and 500kHz.

An overvoltage protection circuit cuts the voltage to the power supply if +UB output voltage exceeds +35V. The overvoltage protection circuit is formed by Q30 and associated components. The overvoltage protection circuit monitors the output voltage via Q3 which is switched on when mains is connected to the unit. When an overvoltage is detected, the dc input voltage to the UB switching regulator is cut by switching off Q5.

A short circuit protection circuit formed by Q4, C2 and associated components, monitors for undervoltage which indicates high current and a possible short circuit. If an undervoltage is detected Q5 is switched off.

A low current detector circuit is incorporated to monitor the output current and ensure that it is not too low (in effect ensuring that the output voltage does not exceed +27V). The low current detector circuit uses a tapping from T1 to monitor the current. The overcurrent detector (ZCUDE of U1) uses the same tapping.

On/Off Control and Low Battery Voltage Monitoring

The supply for the +5 and ±12V regulators is controlled by an on/off control circuit. The switch of the on/off control circuit is Q11. It is initially switched on by the ON signal from the keyboard, and then latched by the OFF signal (logic 1) from the Microprocessor. When the OFF signal from the processor goes low, Q11 is switched off, the power to the switching regulators is cut, and the unit is switched off.

The voltage of the battery is monitored by comparator U6C (monitoring the +US power rail). If the voltage drops below 18.8V (battery voltage low) Q11 is switched off. In the same manner if an overcurrent or overvoltage (+12V) is detected, Q11 is switched off via U7B.

+5V and ±12V Switching Regulators

The 5V and 12V step down switching regulators both function in the same manner. The description given here is for the 12V regulator.

Power Supply (cont.)

Power FETs Q9 and Q10 form a push-pull circuit which switches the supply to loading coil T2. The power FET control circuit is formed by U5A which monitors the ac feedback (via C24) and dc feedback (via R47) to control the switching oscillator (U5B, C17). A gate booster for the power FETs is formed by U4.

Secondary windings of T2 provide voltages of 13V and 25V. These are used by linear voltage regulators to produce the regulated -12V and -18V supplies respectively. The power supply distribution is given on the following table.

POWER SUPPLY DISTRIBUTION

Boards	Power Supplies					
	+5 V (VCC)	+12 V	-12 V	-18V	+UBU Backup	+UB
Processor Board	✓	✓	✓		✓	
LCD/Keyboard Buffer	✓	✓	✓	✓		
Interface Board	✓					✓

Battery Controller

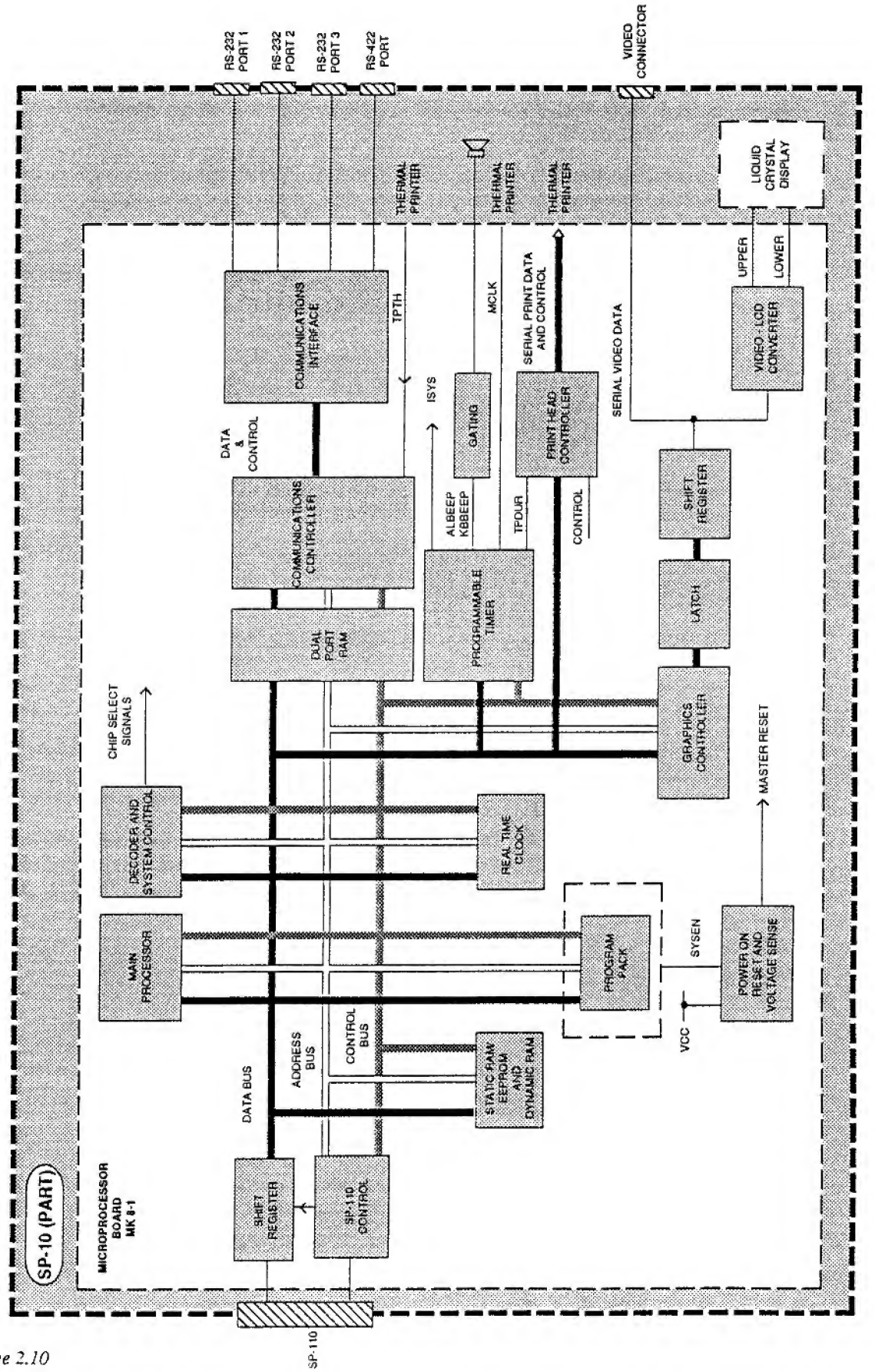
The battery controller circuit measures the charge/discharge current of the battery to enable the CPU to calculate the capacity of the battery. The battery controller circuit also controls the battery LED to give a visual indication when the battery is charging and when the unit is using battery power.

The negative side of the battery is connected to a current sense circuit. Operational amplifier U15B gives an indication to the counter of the current direction ie charging or discharging. Operational amplifiers U15C and U15A form a current rectification and measurement circuit the output of which is fed to a current frequency converter circuit. The current/frequency converter provides a frequency output that is directly proportional to the battery charge or discharge current. The output of the current/frequency converter clocks an up/down counter which is used to indicate the charge/discharge current and charge/discharge time of the battery, and thus the actual capacity of the battery.

The frequency of the current/frequency converter at a charge or discharge rate of 1A is approximately 31.3Hz.

The counter counts up when the battery is discharging and down when the battery is charging. The count is converted to an analog value by D/A converter U13 for use by the CPU in determining the charge state of the battery. When the battery is fully charged ie counter all `1´s, the DAC output is 0V.

The counter is preset when the battery is fully charged. This is carried out by a comparator U14C which acts as a current sense and goes high when the charging rate of the battery is less than 10mA. Via Q23, the PRESET signal goes low and the counter is preset to all `1´s. This circuit is also used (via Q24) to light the battery LED when the battery is charging.



Processor - Functional Block Diagram

Processor Board

CPU

Overall control and coordination of all circuits and all peripherals (with the exception of the paper tray carriage motor), is by the CPU (U46) situated on the Microprocessor Board. The CPU used is the 68000 and it works in conjunction with a dedicated gate array IC (U47). The main functions of the gate array circuit are as follows:

- To decode the address bus (A17 to A23) and generate the chip select (CS) signals for the memory and the peripherals.
- To generate interrupt priority signals (IPL0, IPL1, IPL2) for the main processor - the highest priority interrupt is `7´ the lowest `1´.
- To generate the row address strobe (RAS), column address strobe (CAS) and address multiplex control signals for the Dynamic RAM.

Program Pack

The Program Pack comprises two EPROM chips containing the SP-10 software. The EPROMs each have 256 or 512 kByte of memory which is addressed by Address lines A0 to A20 and enabled by the EPROM CS signal.

Memory

Dynamic RAM

The Dynamic RAM comprises four 1 Mbyte RAM modules. The RAM control signals are generated by the gate array (U47). The RAM data is transparently refreshed via CAS before RAS control protocol at approximately 1kHz. The Dynamic RAM stores the following data:

- Printer pixel pattern
- Printer text data

Static RAM and EEPROM

The two 128k RAM chips (U25 & U26) are addressed via address lines A0 to A19; they are enabled by the CSSRAM signal. The static RAMs use the back-up power supply so that the stored data is not lost when the unit is switched off.

The static RAM stores the following:

- Test Data
- Patient data

The SP-10 EEPROM memory stores some user defined parameter settings and comprises a single 64k EEPROM chip (U27). It shares an enable signal (CSRTCC) with the real time clock (U30).

Processor Board (cont.)

Communications Controller

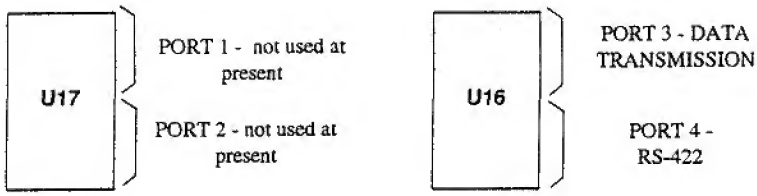
The Communications Controller carries out the following functions:

- Controls the serial ports
- Provides synchronization of the peripheral devices with the CPU

The communications controller comprises a single chip processor (U14) with built in RAM and ROM to control the serial interfaces and Data I/O ports. Data between the Communications Controller and the CPU, is via a dual port RAM (U13) which acts as a data buffer. It is selected by the CSCC signal.

Temperature signal from the thermal print head is input to the A/D converter of the communications controller processor.

Communication over the RS ports is via Dual Communication Interface Controllers. Each of the controllers monitor two RS ports as follows:



The enable signals for the communication controllers are generated by U14 via a binary to octal converter (U15).

Thermal Print Head Controller

The Thermal Print Head Controller circuit comprises programmable generic array logic (GAL) chips and latch buffers. Data to be printed is presented on the data bus and strobed through first in, first out (FIFO) memories (U60 and U61) in two bytes (lower - D0 to D7, upper D8 to D15). The 10 input, 8 output GALs are programmed to serialise data from the FIFOs memories and send it in the required format for the printer. To ensure a superior quality print the print head data is `cycled´ so that each pulse is repeated eight times. This is carried out by FIFO memory U59.

TPD is the print head serial data signal, TPS0 and TPS1 are printer strobes, and TP clock is the 4 MHz serial data clock. The output to the printer is synchronized with the 1.9kHz clock. The temperature control for the print head is set by the TPDUR signal (thermal print duration from the programmable timer), which is strobed by signal TGATE (6kHz).

Processor Board (cont.)

Programmable Printer Timer and Beeper

The Timer circuit comprises U28 and U29 which decode the timing instructions from the CPU encoded on the data bus. The Timers are accessed by the CSEE signal. The timing signals produced are as follows:

- MCLK — The printer motor clock. The faster the speed of the motor the faster the paper feed.
- ISYS — A general purpose timing clock of 2 kHz, used as system interrupt (determines sampling rate, printing rate etc.)
- TPDUR — The duration that the print head is heated. This is calculated by the CPU, from the resistance of the print head and the measured ambient temperature of the print head.
- ALBEEP, KBBEEP — Audio signals for the alarm and keyboard beeper.

The timers are addressed by address line A1 and A2 to select the required timing. The frequency of the master clock input, is 5 MHz.

Graphics Controller

A VGA standard signal (480 rows with 640 pixels/row with a horizontal sync of approximately 31.8 kHz and a vertical sync of 60 Hz), is generated by a graphics processor chip (U39) and associated components. The video controller also generates all the necessary protocol signals (HSYNC, VSYNC etc).

The parallel data output of the video controller is fed to two 8-bit shift registers (U33 and U34) which together convert the 16-bit parallel output from the video controller to the required serial video output. Two RAM chips (U31 and U32) form a latch circuit for the pixel memory and allow picture freeze when required. The video signal to the Video/LCD Converter is gated with signal SCINV which inverts the screen image (changes the LCD to white on black image), when set.

Certain control and enable signals from the video controller are further decoded by GAL U38.

Video - LCD Converter

The video/LCD converter chip (U74) generates all the timing and strobe signals required by the LCD and converts the serial video signal into the correct format for display. Four upper and four lower control and data signals are output to the LCD along with two clock signals. A working memory for the converter chip is provided (U75).

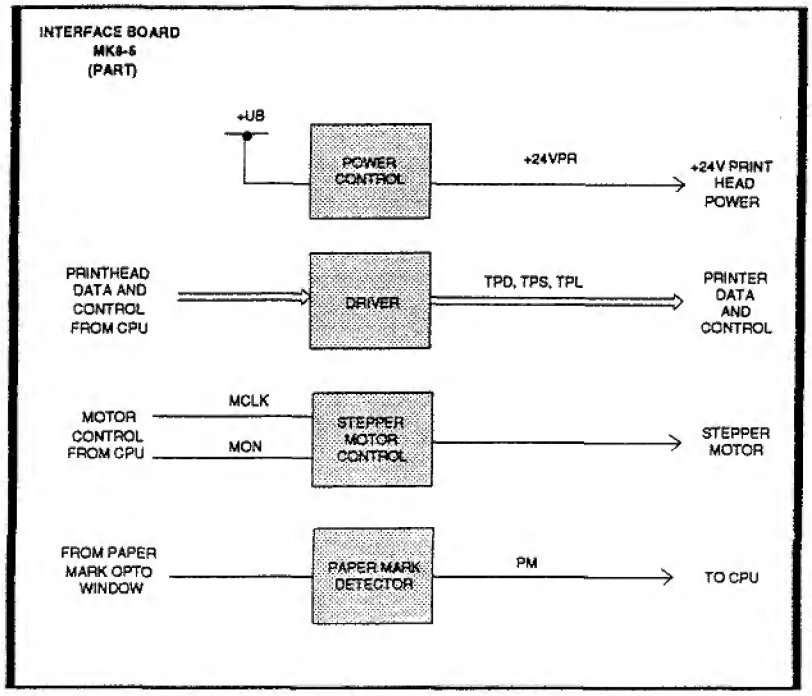
Power On Reset

The Power on reset circuit is formed by U54 and associated components. The circuit controls the master reset of the CPU. This circuit has three functions as follows:

- Provides a delay on initial switch on to ensure that the power supply is fully stabilized and to give the 200ms reset time required by the 68000 processor.
- Ensures that the system is inoperative and in Reset mode when the SYSEN indicates that the Program Pack is not present
- Disables the unit if the +5V rail drops below +4.75V.

Interface Board

Thermal Printer Control



The Thermal Printer stepper motor is controlled by stepper motor controller U1. The MON signal from the processor is the enable signal for the controller and the MCLK signal sets the speed; 209Hz gives a paper speed of 2.5 mm/s, 2.09kHz gives a paper speed of 25 mm/s. The driver circuit incorporates a current sense circuit. If the current drawn is greater than 100 mA the sense signal is active and the motor stopped. Pull-up resistors on the output lines protect against spikes from the stepper motor.

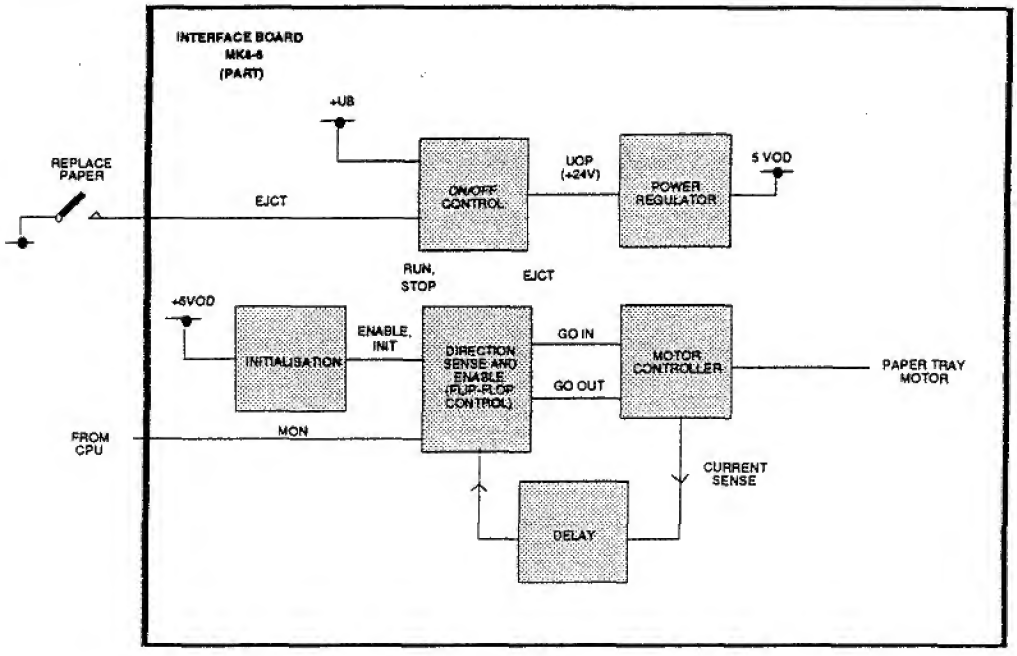
The printer data, the strobe and the clock signals are buffered by U5. The strobe frequencies (TPS0 and TPS1) are 2kHz, the clock (TPCLCK) is 4MHz, and the latch frequency (TPL) is 2kHz.

Because of the high power peaks drawn by the TPH, reservoir capacitors on the +24V rail ensure a stable supply to the thermal print head (via the controller).

The paper mark detector is an opto sense circuit. The output from the detector is fed to an operational amplifier (U4) to set the PM signal when a paper mark is detected. The input from the optocoupler is 0.4V to 0.6V for white paper and 3.5V to 4.0V for black paper ie paper mark. The PM output is logic 0 when a paper mark is detected.

Interface Board (cont.)

Paper Carriage Control



The paper tray carriage motor control circuit works independently from the CPU and has its own power supply which is enabled only when the paper tray is in use; when the paper tray is not extended, the power supply is inactive.

Paper Tray Not Extended

Pressing the REPLACE PAPER key switches the power supply on and presets some internal signals to a preset circuit state. Signal EJCT switches transistor Q7 on to generate +Uop from the +UB supply. +Uop is regulated by U4C to generate the +5V supply (5Vod) and Q7 is latched on by the 5Vod supply.

The 5Vod also acts as the `start signal´ to operate the motor via a delay and timing circuit formed by U6C, U6D and associated components. This sets the ENABLE and INIT signals to flip-flops U7A and U7B. The flip-flops enable the motor control chip U8 and set the direction of the 24V dual polarity motor (GO IN, GO OUT signals). The motor controller incorporates an `H´ bridge current sense circuit and when the paper tray is fully extended the motor controller sets the sense line which is fed back via a delay circuit, to reset the flip-flops and stop the motor. The delay circuit (C34) is incorporated to prevent the motor being stopped prematurely during the power surge when the motor is initially activated.

Interface Board (cont.)

Paper Tray Extended

When the paper tray is extended, pressing the REPLACE PAPER key switches off transistor Q8 and activates the EJECT signal. This sets the clock input to the flip-flops and activates the GO IN signal to the motor controller. In the same manner as when the paper tray is being extended, the current sense circuit stops the motor when the paper tray has fully returned.

When the tray has returned, the DIR IN signal is active which switches Q9 on, and Q7 off. This cuts the +Uop rail and switches off the power supply.

The flip-flop control circuit monitors the printer motor via the MON signal, and the paper tray motor via the run signal (paper tray motor active). This ensures that the circuit is disabled if the REPLACE PAPER key is pressed when either the printer motor, or paper tray motors are active.

Chapter 3
Fault Diagnosis and Check Procedures

Contents

Introduction

The purpose of this chapter is to provide fault-finding procedures that will quickly and efficiently identify a fault on an SP-10 to a specific module. The fault-finding procedures are designed so that test equipment is kept to a minimum.

An initial fault diagnosis chart is provided detailing all the general fault indications that may occur. When this is followed it will indicate the module where the fault lies or specify a further fault-finding procedure. When more than one module is stated, the first module given is the one most likely to contain the fault. If the fault is not found on the first module, the other modules should be checked in the order given.

If the initial fault-finding chart does not indicate the area where the fault exists, re-check all the settings and parameters that have been entered (for the particular task that fails). If these are correct, check the software. If this is correct suspect external connections.

When a key operation or menu selection is required when carrying out the functional checks after replacement, the key sequence required is given in parenthesis '<>'. The character(s) given in parenthesis is the actual character(s) printed on the key. When a key sequence is provided it must be followed in the order given.

Test Equipment

The following proprietary and dedicated test equipment is the minimum that is required to fault find and carry out any board checks and adjustments, on the SP-10.

The list of proprietary equipment is not comprehensive. Recommendations of suitable proprietary test equipment can be obtained from the Schiller Service Department

Dedicated Test Equipment

◊ RS Test Cable Assembly required for the RS self test

Proprietary Test Equipment/Tools

◊ Calibration Pump (2litres or more)*

◊ Oscilloscope

◊ Digital Multimeter*

◊ Stabilised Power Supply

◊ Standard tool kit with a selection of cross-bladed and flat-bladed screwdrivers, Pliers and general tools*

◊ Soldering Iron

◊ VGA Monitor

* Indicates Essential Equipment for basic SP-10 fault finding

Special Tools / Equipment

The following table lists all the special tools and equipment that may be required when fault finding or carrying out certain maintenance procedures on the SP-10.

DESCRIPTION	PART NUMBER
RS TEST CABLE ASSEMBLY 3-WAY CONNECTORS	2. 310 042
2MM HEXAGONAL KEY FOR THE REMOVAL /REPLACEMENT OF THE PROGRAM PACK	STANDARD TOOL AVAILABLE ON THE MARKET
HEXAGONAL CROSS-BLADED SCREWDRIVER USED FOR THE REMOVAL AND REPLACEMENT OF THE PRINT HEAD	SCHILLER NUMBER 4.950074. MANUFACTURED BY WERA, NUMBER - WERA 367 TX 210180

Fault Diagnosis

Use the fault finding charts and procedures on the following pages to indicate a faulty area or module. In most cases the fault finding charts should indicate the most likely faulty area.

When a possible faulty module is indicated by the fault finding charts, the module must be replaced. When a module has been replaced specific test parameters and setting-up of the module may be applicable. The Removal and Replacement instructions for all replaceable modules, along with any set-up or check procedures required, are given in Chapter 4.

Warnings & Cautions

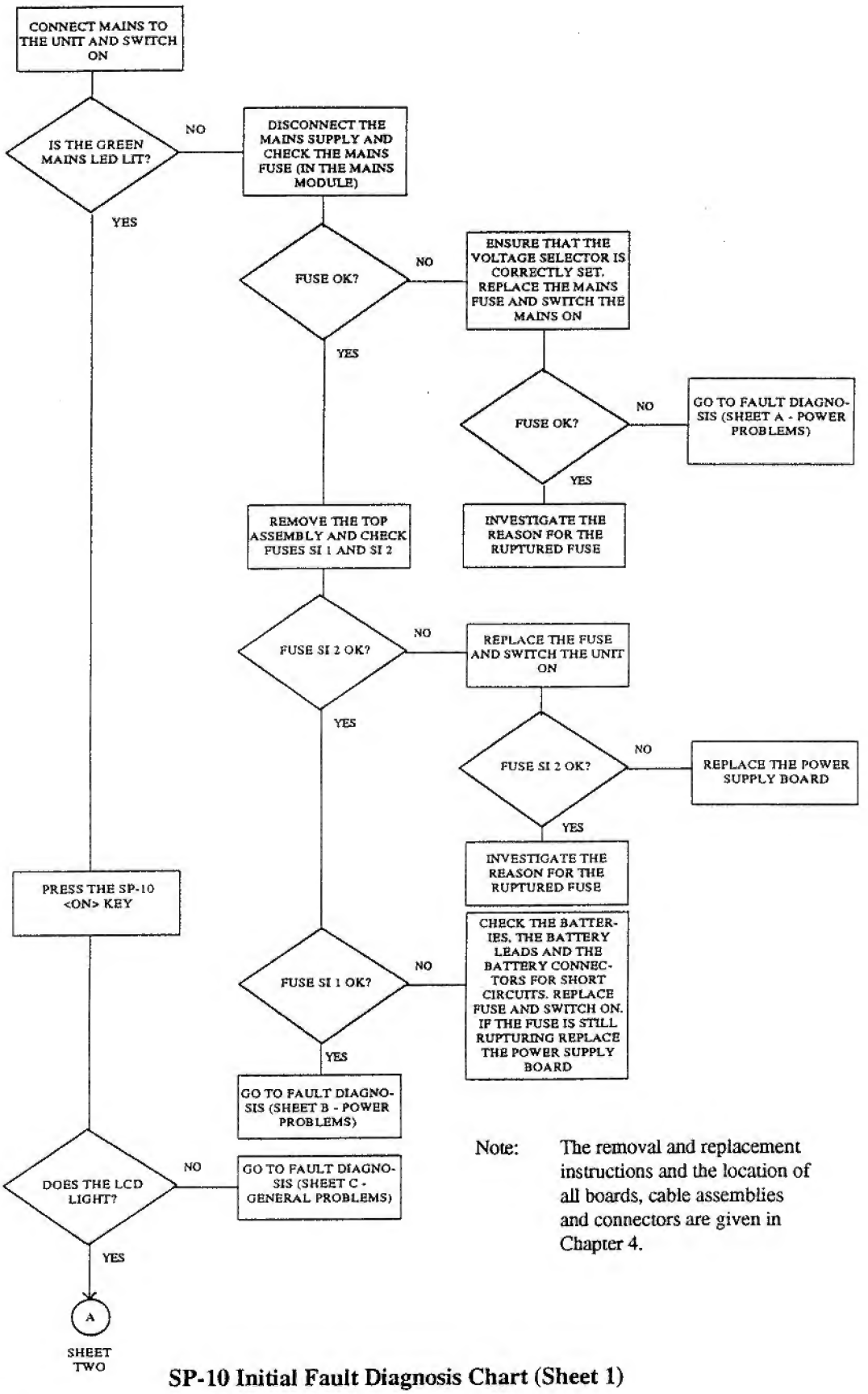
WARNINGS

MAINS POWER IS PRESENT WHEN THE UNIT COVER IS REMOVED. CERTAIN CHECKS AND ADJUSTMENTS CAN ONLY BE CARRIED OUT WITH THE TOP ASSEMBLY REMOVED AND MAINS CONNECTED. WHEN CARRYING OUT THESE PROCEDURES BEWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

CAUTIONS

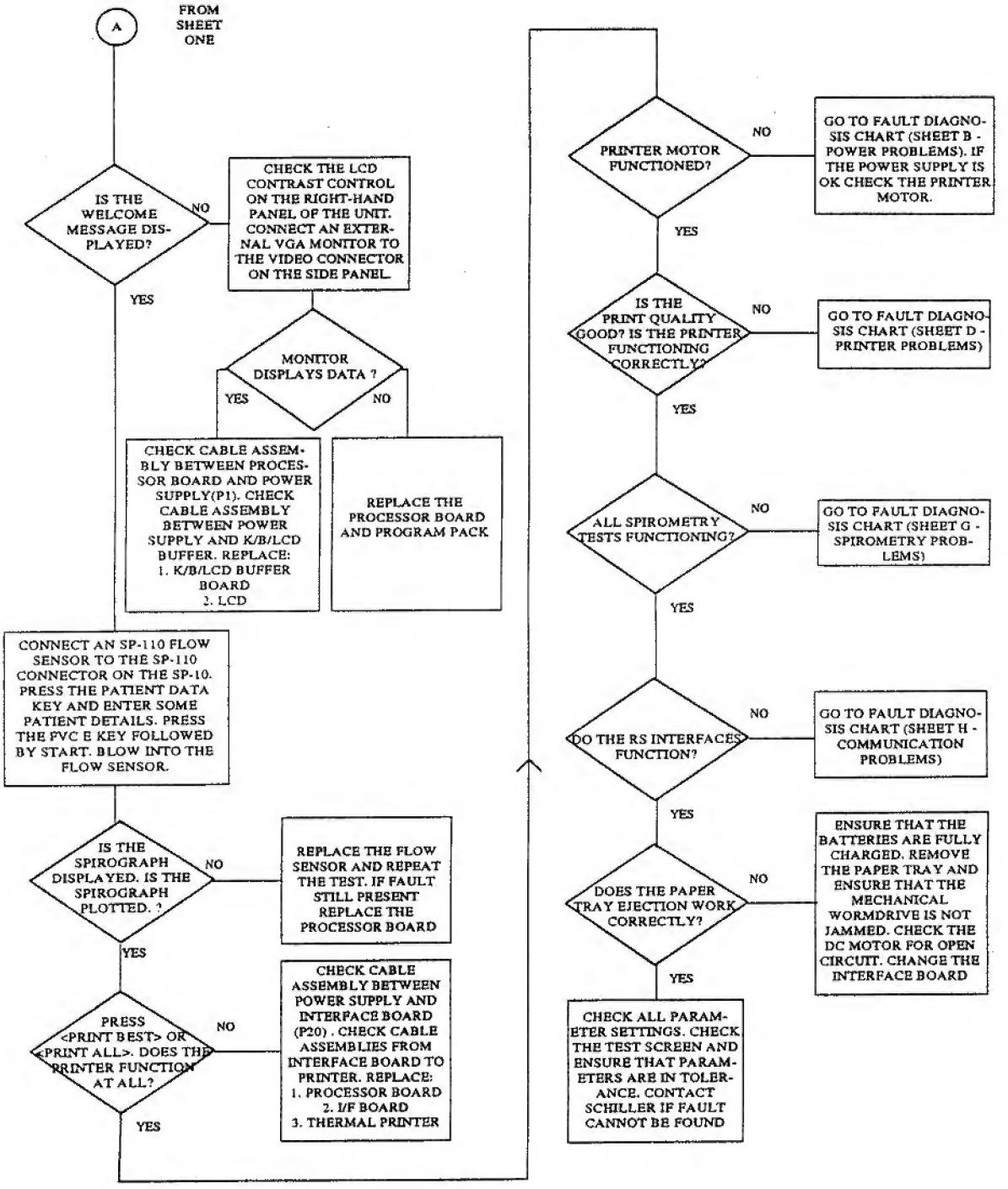
THE SP-10 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTI-STATIC PRECAUTIONS. ALWAYS PLACE THE UNIT ON AN EARTHED ANTI-STATIC MAT WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES. PERSONNEL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS. ALWAYS USE AN ANTI-STATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

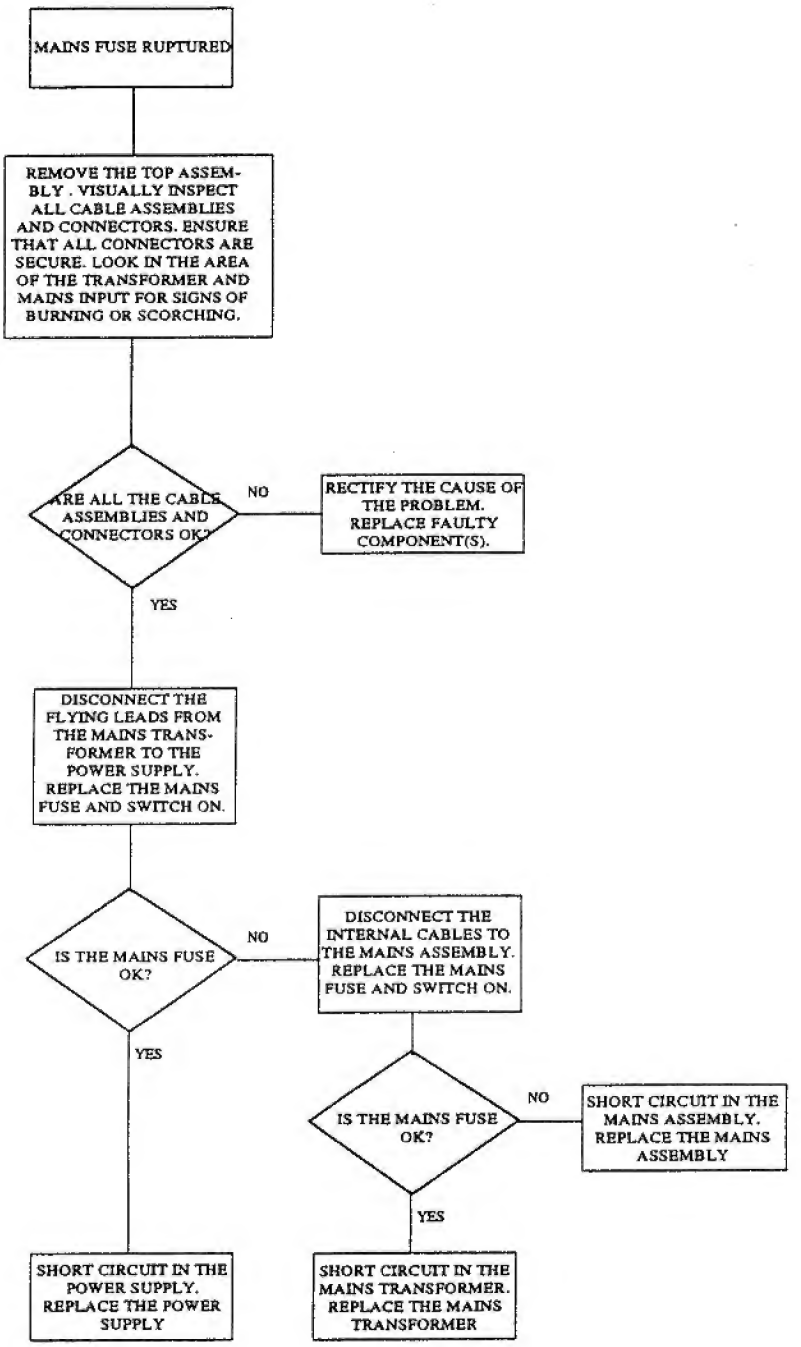


Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Initial Fault Diagnosis Chart (Sheet 1)

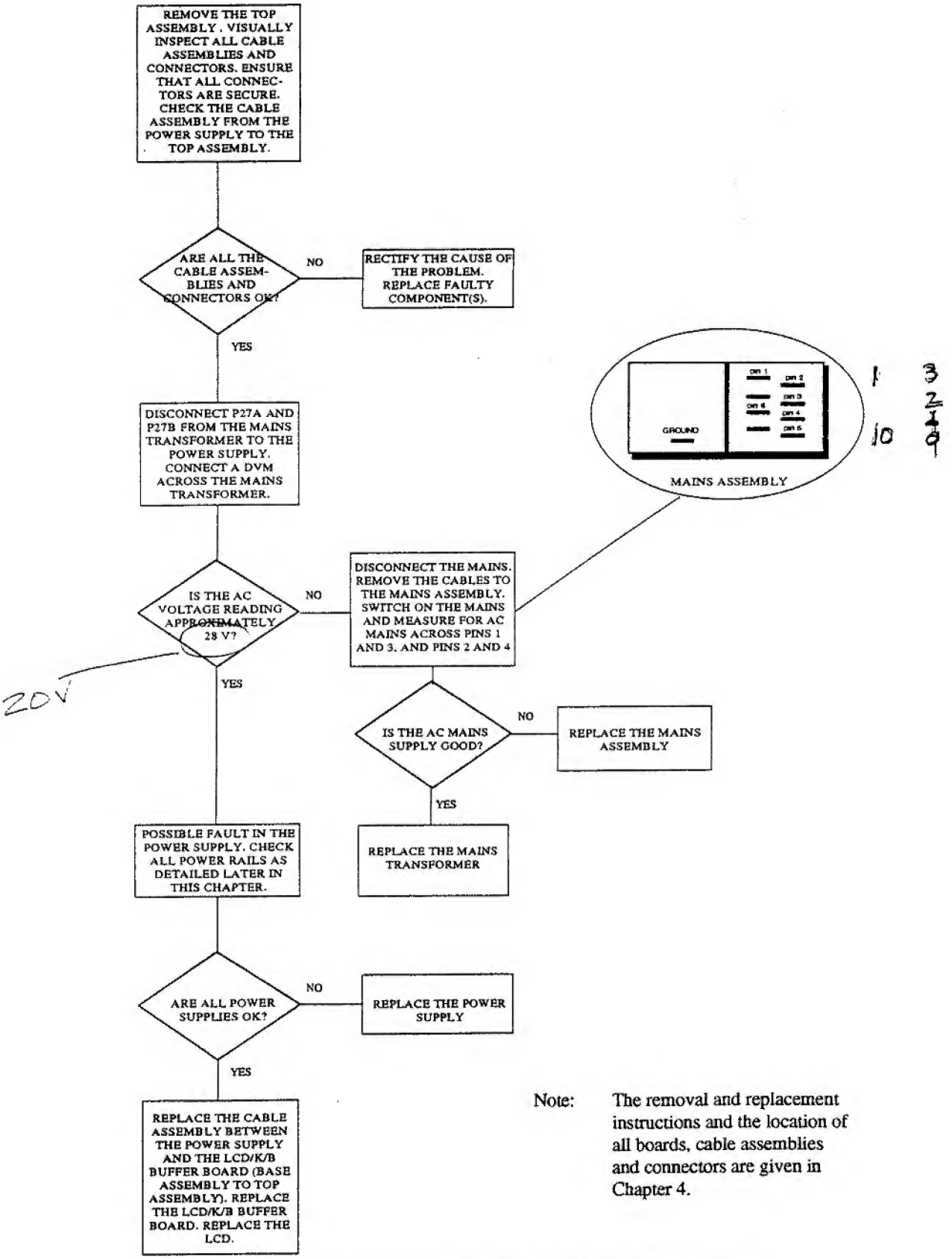


SP-10 Initial Fault Diagnosis Chart (Sheet 2)



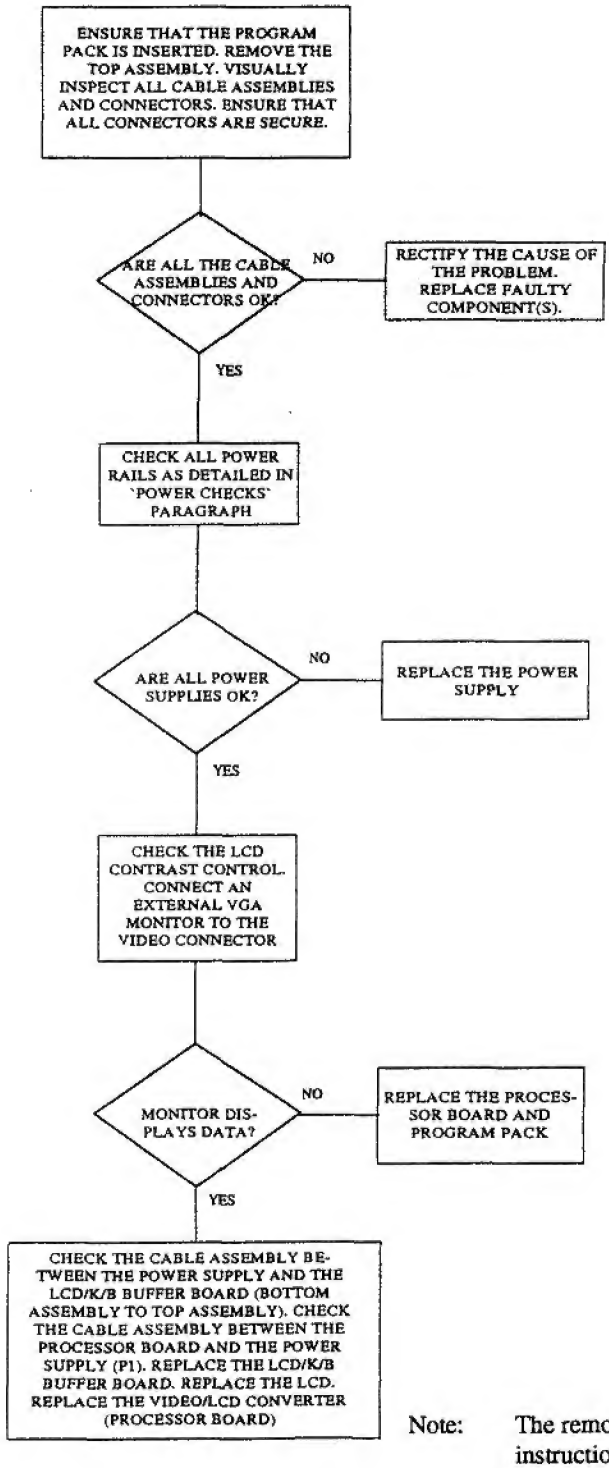
Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet A - Power Problems)



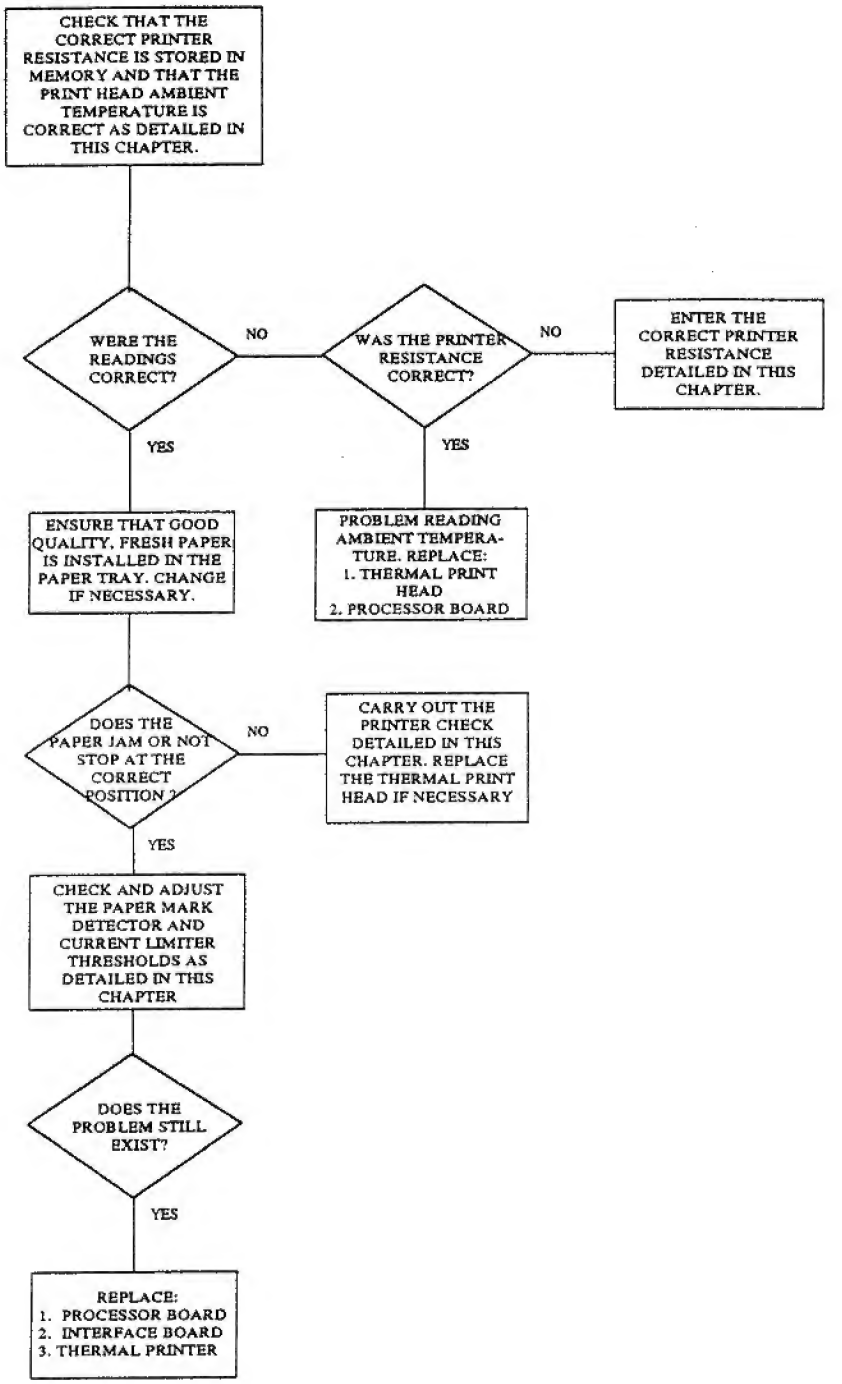
Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet B - Power Problems)



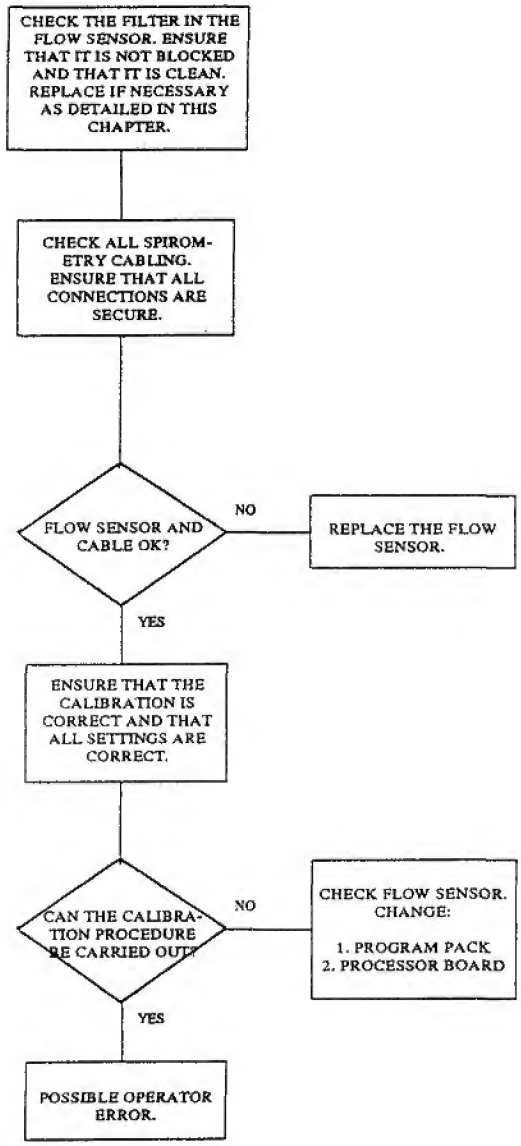
Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet C - General Problems)



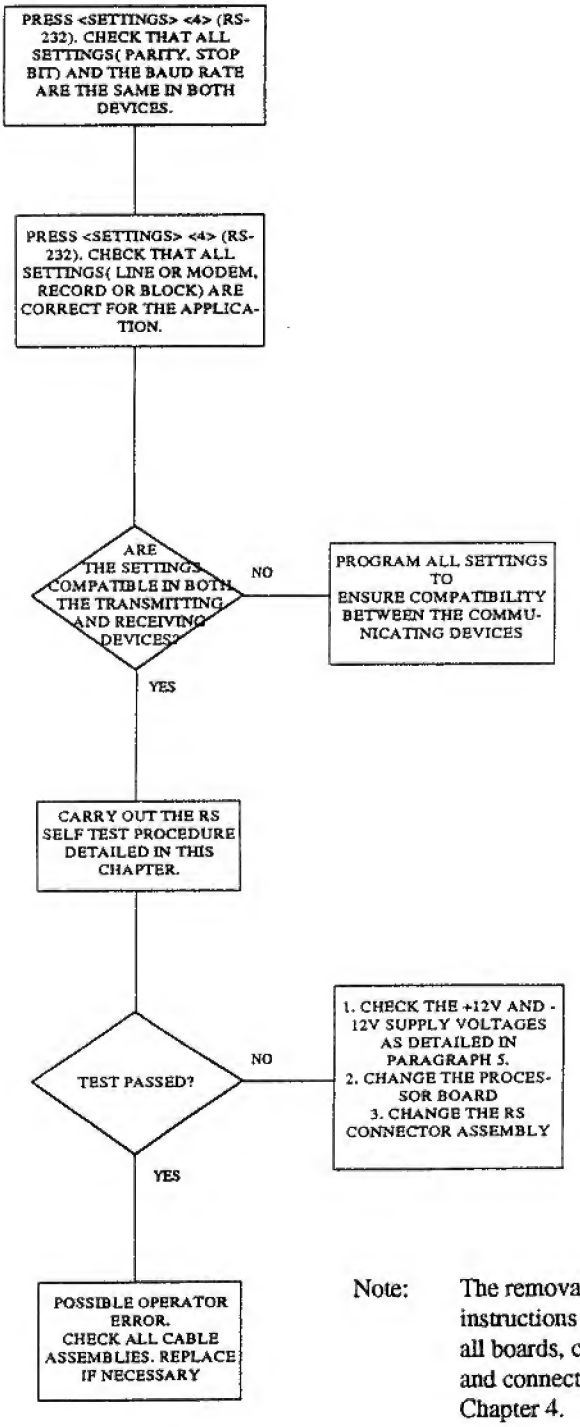
Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet D - Printer Problems)



Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet G - Spirometry Problems)



Note: The removal and replacement instructions and the location of all boards, cable assemblies and connectors are given in Chapter 4.

SP-10 Fault Diagnosis Chart (Sheet H - Communication (RS) Problems)

Check and Adjustment Procedures

General Confidence Check and Calibration Procedure

The procedure detailed here is a general confidence check in the unit after an internal module or board has been replaced. It is not a full functional test but is intended to identify any faults that may be present after the unit has been reassembled. To carry out the general confidence check of the SP-10 proceed as follows:

1. Ensure that the voltage selector on the back panel is set for the required voltage and connect mains to the unit. Switch on the mains and ensure that the green mains LED lights.

2. Connect the flow sensor SP-110 to the connector on the right hand panel of the unit. Connect a calibration pump to the sensor.

3. Switch the unit on by pressing the <ON> key on the Keyboard. Ensure that the LCD lights and that for a few seconds the test screen is displayed at the bottom of the screen. When the test screen disappears, check that the welcome display is given and that the date and time are shown in the data box in the right hand corner of the LCD.

4. Press <SETTINGS> <1> and enter the time and date details. Press <FNCT> when complete. Ensure that the correct date and time is displayed on the screen.

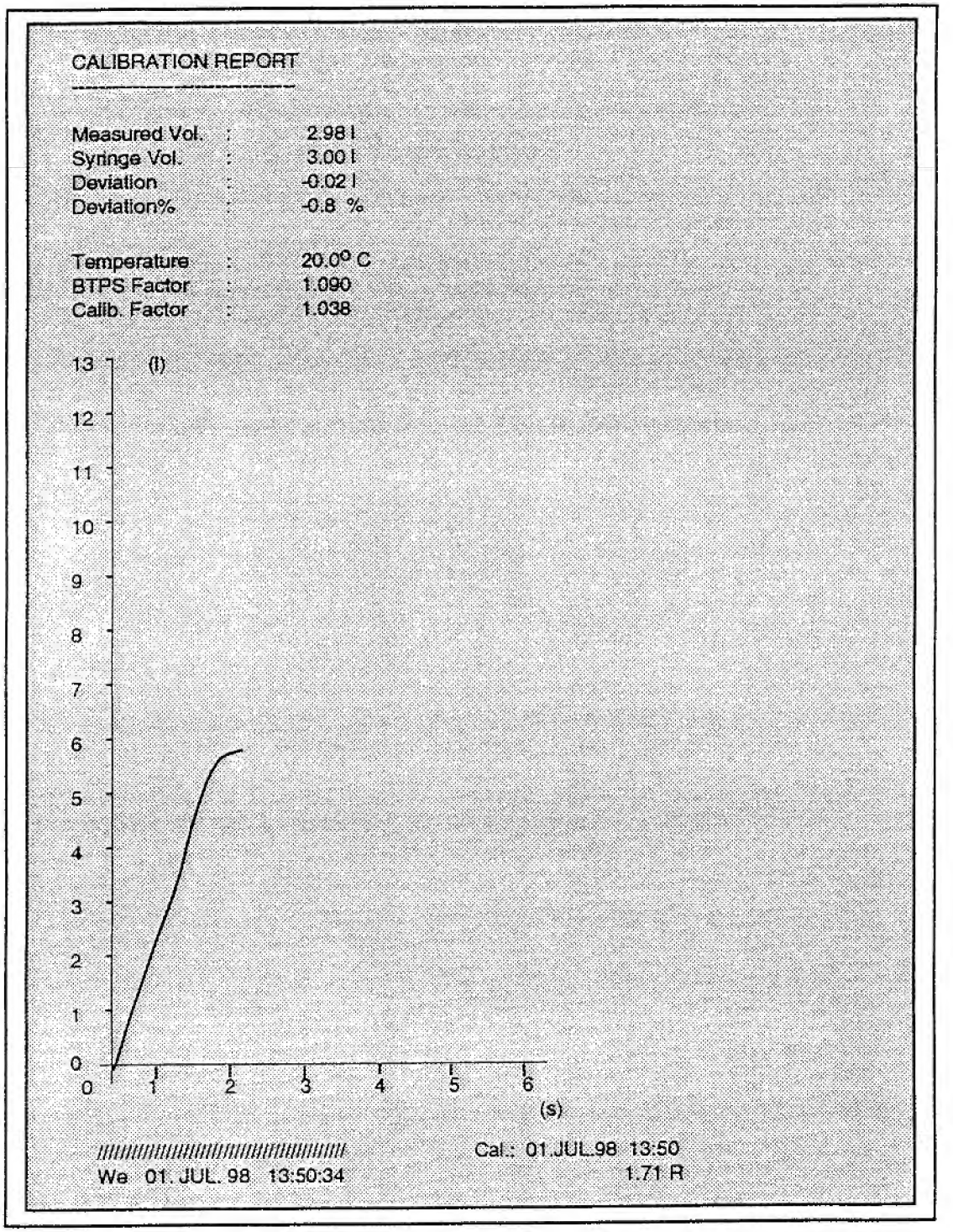
5. Press the <CALIBRATION> key. Enter the ambient temperature and press <ENTER>. Press <START> and empty the calibration pump[§]. Press <ENTER> and at the prompt `Effective Vol`, enter the calibrated volume of the pump, in litres.

   [§]Note: To obtain a more accurate calibration, it is recommended that the calibration pump is emptied more than once to achieve a total volume of more than 6 litres.

6. Repeat step 5 and ensure that the measured volume is correct. If required a print-out of the calibration can be obtained by pressing the <PRINT SEL> key. The print-out obtained gives the following data:

   - ◊ Measured Vol : The calculated volume using the existing calibration.
   - ◊ Effective Vol : : The actual volume received by the SP-10 (that is the calibration pump volume) entered manually by the user.
   - ◊ Deviation : The difference between the measured volume and the actual volume
   - ◊ Temperature : The ambient temperature entered by the user
   - ◊ BTPS Factor : The Body Temperature Pressure Saturated factor compensates for the difference in inhaled and exhaled humidity, and is applied to all subsequent readings (that is, all readings apart from the calibration procedure (as opposed to the ATPS (Ambient Temperature Pressure Saturated))
   - ◊ Calib. Factor : The calibration factor is a software calculated factor which is individually set for the attached transducer and used by the SP-10 in volume calculations

7. Ensure that the print-out is even and of good quality.


CALIBRATION REPORT
Measured Vol. : 2.98 l
Syringe Vol. : 3.00 l
Deviation : -0.02 l
Deviation% : -0.8 %
Temperature : 20.0° C
BTPS Factor : 1.090
Calib. Factor : 1.038
13 (l)
12
11
10
9
8
7
6
5
4
3
2
1
0
0 1 2 3 4 5 6
(s)
We 01. JUL. 98 13:50:34
Cal.: 01.JUL.98 13:50
1.71 R

Check and Adjustment Procedures (cont.)

Note: If the print-out quality is poor and the printer has not been changed, the stored printer resistance data may have been lost from memory. To check the stored resistance setting see Paragraph `Self Test Screens and Offset Adjustments´. If problems are experienced with paper mark detection or setting the printer speed it may be necessary to adjust the factory pre-sets on the Interface board.

8. Press the <PATIENT DATA> key and systematically press the keys:

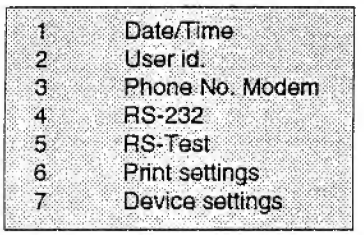
   <QWERTY UIOP>, <ENTER>, <1234567890>

   Ensure that the entered data is correctly presented on the screen as entered. Press <FNCT> to exit the patient data display.

9. Select a test key (eg <FVCE>) and press <START>. With the calibration pump, or manually blow into the flow sensor. Ensure that the pulmonary graph is traced on the screen and that after six seconds the unit prompts for the second reading.

10. Press the <PRINT ALL> OR <PRINT BEST> key and ensure that the print-out is accurate and of good quality.

11. Press <SETTINGS> key and ensure that the settings menu is displayed as follows:



Note: A full description of the programmable parameters and settings, and the procedure to change them, is provided in the SP-10 Operating Manual.

12. If a module has been replaced carry out the checks and tests detailed in the relative Paragraph (if not already carried out). Switch the unit off and leave connected to the mains supply for 24 hours to fully charge the battery.

Check and Adjustment Procedures (cont.)

Power Supply

1. Connect mains to the unit and switch on. Ensure that the mains LED lights and the Battery LED lights. (Ensure that when the battery is fully charged - maximum 15 hours - the battery light is extinguished when mains is still connected).
2. Connect an SP-110 flow sensor to the SP-10. Switch the unit on and ensure that the LCD lights and that the welcome screen is displayed.
3. Press the FVC E key followed by START. Blow into the sensor and ensure that the spirograph is plotted.
4. Press the <PRINT SEL.> key and select Meas 1. Ensure that a print-out of the last measurement is given. Ensure that the print-out is of good quality and is complete.
5. Press any key and ensure that the buzzer beeps.
6. Check the ±12V supplies and communications interface by carrying out the RS test procedure detailed in this chapter.
7. Disconnect the mains supply and ensure that the mains LED is extinguished and that the yellow battery LED lights.

If these checks are satisfactory it indicates that all the power supply rails are correct. If any of the checks fail, the individual power supplies must be checked.

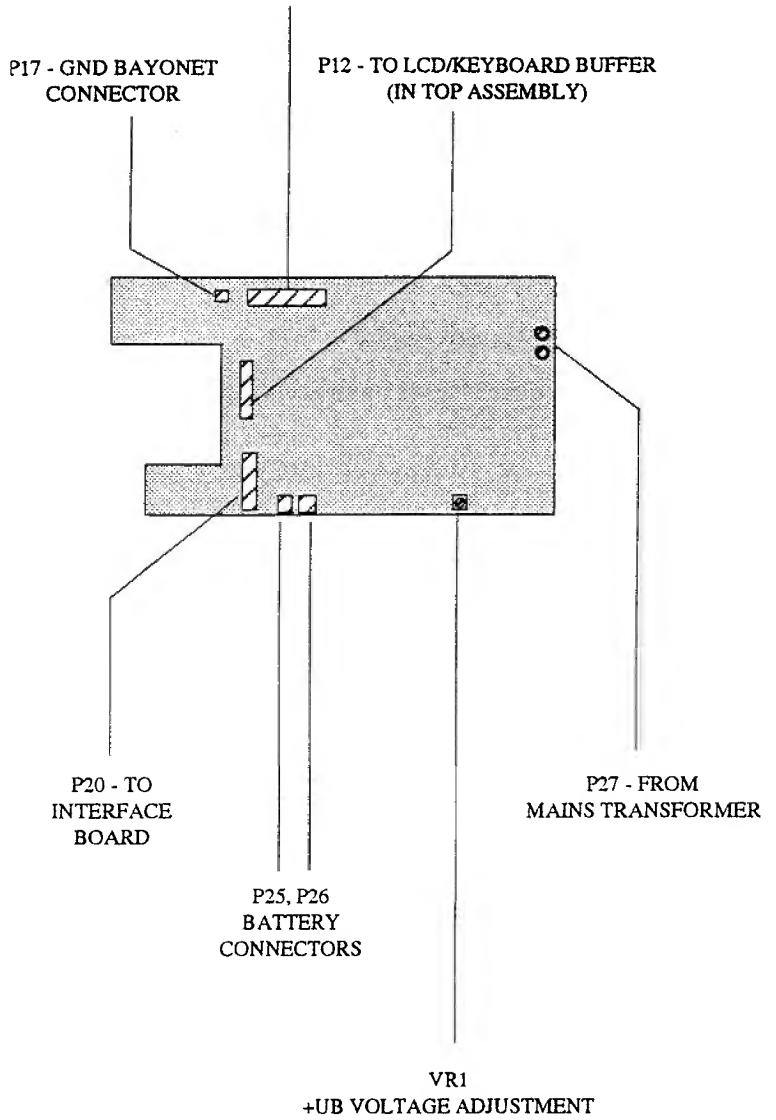
Power Rail Adjustment Procedure

The power supply voltages can be checked in isolation; it is not a requirement that the unit has to be assembled to check the power supplies. If the power supplies are checked when the Power Supply is connected to the Processor board however, a more accurate measurement may be achieved.

Test measuring points are provided on the Power Supply board for measurement of all power rails.

Individual adjustment is not possible for any of the voltage rails except +UB (from which all other supplies are generated and the batteries are charged).

Check and Adjustment Procedures (cont.)



Power Supply Board MK 8-6

Check and Adjustment Procedures (cont.)

WARNING

LETHAL VOLTAGES ARE PRESENT WHEN CHECKING AND ADJUSTING THE POWER SUPPLY. DO NOT LET CONCENTRATION LAPSE. EXERCISE GREAT CARE WHEN TAKING MEASUREMENTS.

ON Signal Simulation

A latch circuit exists on the power supply. If the Power Supply board is checked in isolation the ON signal must be connected to GND. To simulate the ON signal, proceed as follows:

1. Connect mains to the unit and switch the mains on.
2. Using a suitable lead, connect GND to Plug P12 pin 25, and hold for 2 seconds. The power supply will now be latched on and all generated power supplies can be checked for the correct voltage.

Note: To switch the power supply off, connect GND to P1 pin 50.

+UB Adjustment

To check and adjust +UB supply proceed as follows:

1. Connect mains power to the unit and switch on. Latch the power supply on, as detailed above.
2. Measure the voltage at connector P25 pin 1. Adjust VR1 to achieve a voltage of +27V ±200mV.

   Note: The test point where measurement is taken is situated after the On/Off switch. If no voltage is present ensure that the on/off switch Q11, is switched on. To check the voltage before the On/Off switch measure the voltage on fuse SI2.

Power Rail Measurement

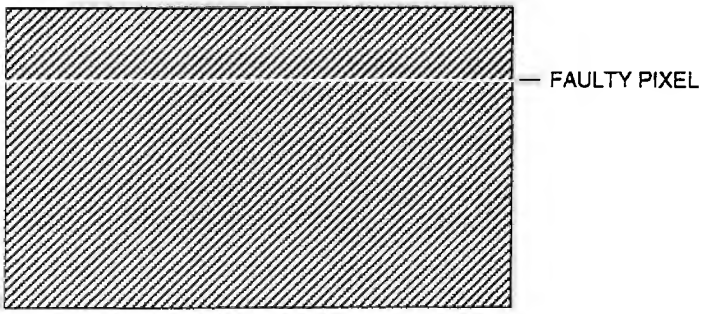
No adjustment is possible for any of the power rails. To check the power rail voltages go on the relevant connector pin and measure with a DVM. If any of the values are out of tolerance first ensure that +UB voltage is correct. If this is correct the power supply must be changed.

Check and Adjustment Procedures (cont.)

Printer

To check the printer and to ensure that every pixel is operational, a built-in printer test is provided. The printer check is entered from the settings menu; press the <SETTINGS> key on the left of the keypad, to display the settings menu and press <P> to commence the printer test.

<SETTINGS> <P>



A print-out of a series of diagonal lines will be given. Carefully examine the print-out and ensure that all the lines are even and uninterrupted. Any faulty print-head pixels will be seen as a horizontal white line. Examine the print-out for evenness of print.

If a faulty pixel is detected the printer must be replaced. If the print-out is uneven (for example darker at the top than the bottom), it indicates that the printer alignment is not correct. If the print-out is too faint or too dark, check that the correct resistance is entered in memory as detailed in Paragraph `Printer Resistance` below.

Printer Resistance

Check that the correct resistance of the printer is entered in the SP-10 memory as follows:

Note: The printer resistance will be found on a label attached to the printer.

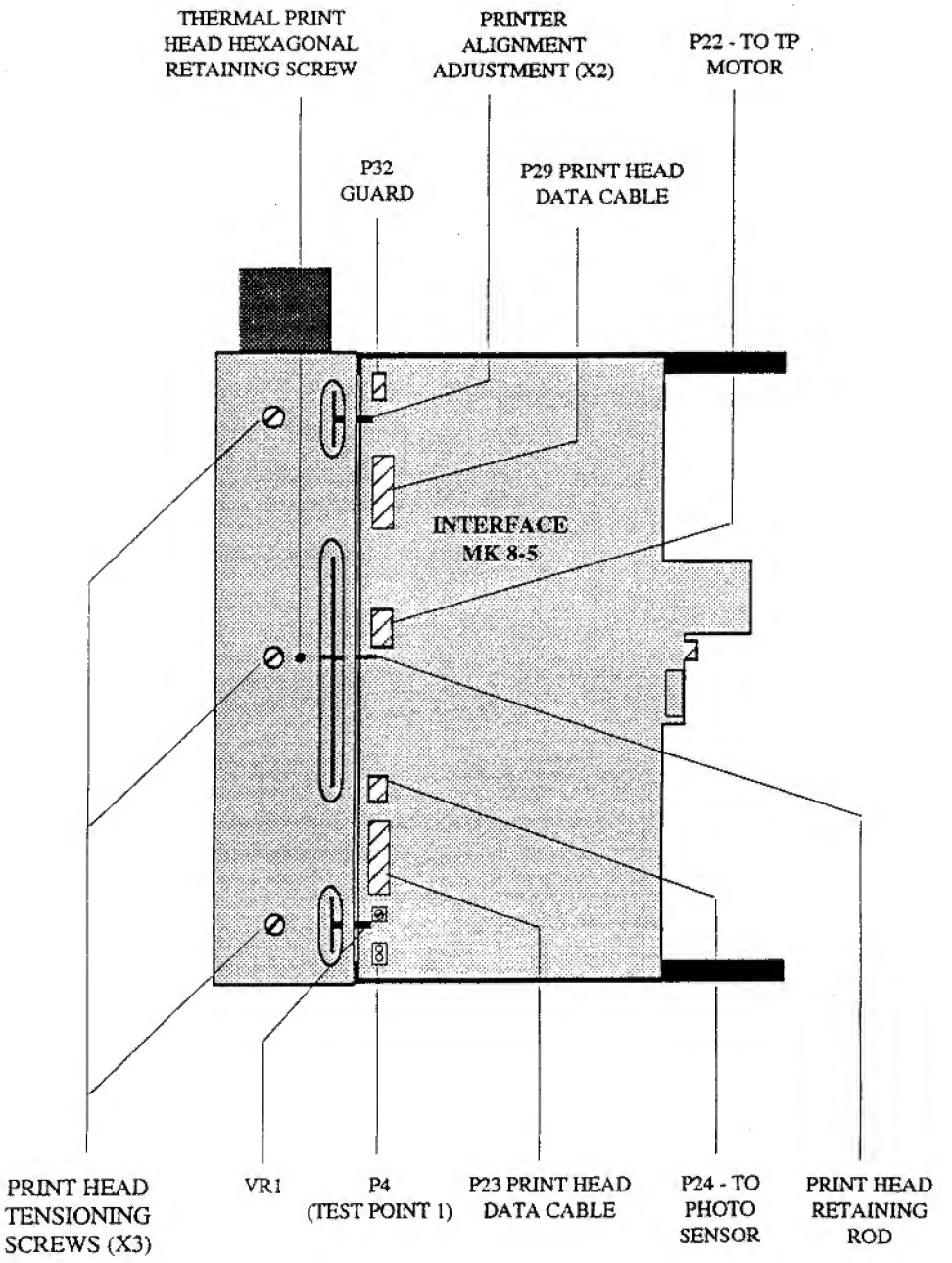
1. Display the settings menu by pressing the <SETTINGS> key on the left of the keypad. When in the settings menu press <T> (Test).
2. R TPH is the resistance of the printer (See Paragraph `Service Screen` for the display that is shown). To enter a new resistance press </> (slash key). The first figure of the resistance value is highlighted and the correct resistance can be entered. When the correct resistance value has been entered, press <ENTER> to save the setting. Note that the SP-10 will only accept a resistance range of between 1000 and 1800 Ohms.

3. Battery Test Screen (B voltage, B cap)

Check and Adjustment Procedures (cont.)

Print Head Alignment

Printer alignment is achieved with the three print head alignment (tensioning) screws. Adjust the screws so that they are slightly indented below the frame. Adjust to achieve the best quality print-out.



RS Interface Testing

RS Interface Error messages

The following error messages are associated with the RS Interface. If any of these error messages are displayed, carry out the checks suggested.

SERIAL LINK TIME-OUT

This indication appears if no signal is received from the remote unit (after approximately 30 seconds).

- ◊ Check that the remote unit is switched on and set to the correct parameters
- ◊ Check the correct set-up in both units (<STORAGE> key)
- ◊ Check that the connecting cable is correctly plugged in
- ◊ Check the integrity of the cable assemblies (at both units)
- ◊ If using a modem ensure that it is communicating with the remote modem

TRANSMISSION ERROR
or DATA SET NOT READY

This is a general fault indication

- ◊ Check that the remote unit is switched on and set to the correct parameters
- ◊ Check that the connecting cable is correctly plugged in
- ◊ Check the integrity of the cable assemblies (at both units)
- ◊ If using a modem, ensure that it is communicating with the remote modem

NO DATA IN MEMORY

A data transmission has been attempted, but no data is stored in the units' memory. Store a measurement in the memory and attempt the transmission again. If the same message appears, change the Processor board.

RS Self Test with Test Plug

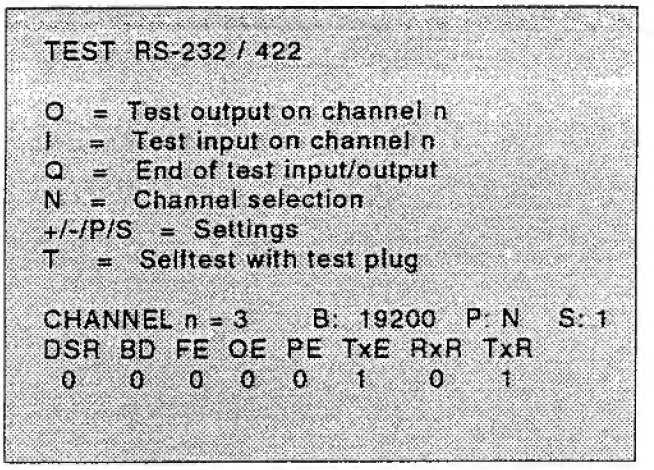
The RS interface self test ensures that the RS communication circuit on the Processor board is functioning. To carry out the RS self test proceed as follows:

1. Connect the RS test cable to RS ports 1, 2, and 3 as indicated on the RS plugs.
2. Switch the SP-10 on. Press the <SETTINGS) key to display the settings menu

1	Date/Time
2	User id.
3	Phone No. Modem
4	RS-232
5	RS-Test
6	Print settings
7	Device settings

Select option RS-test (menu option 5) to display the RS-test options:

RS Interface Testing (cont.)



3. Press <T> to commence the RS self test with test plug.

The self test starts and a pass (audio sequence) or fail (TRANSMISSION ERROR) message appears on the LCD. An audible indication is given that the test is complete.

Test Failure

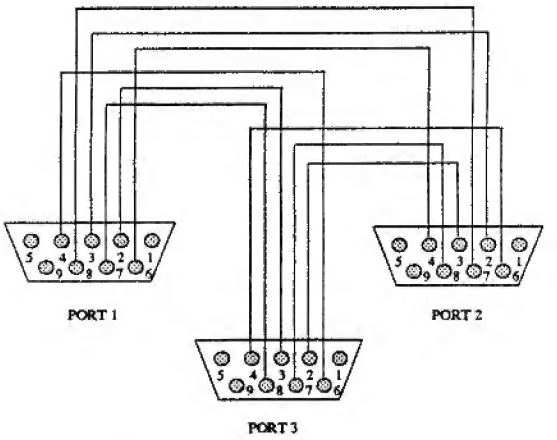
If this test fails ensure that the cable assembly is wired and connected correctly. If the test cable assembly is correct, a fault is indicated on the Processor Board or Power Supply.

Test Pass

When this test passes it indicates that the SP-10 is functioning correctly and that the fault lies in the remote equipment, the transmission line or that the protocol of the two communicating devices are incompatible.

- Check that all settings (Parity, Stop bit) and the Baud rate are the same in both devices.
- Reset all settings to ensure compatibility between the communicating devices. Check that all settings (Line or Modem, Record or Block) are correct for the application. Are the settings compatible in both the transmitting and receiving devices?
- Check the integrity of all cable connections. Are all cables correctly connected to the programmed port?

RS Interface Testing (cont.)



RS Test Cable Art. No. 2. 310 042

RS 232 Pin Connections	
PIN	**SIGNAL**
3	Out (Data Output)
2	In (Input Data)
7	RTS1 (Output - Request to Send)
8	CTS1 (Input - Clear to Send)
6	DSR1 (Input - Receive Unit Ready)
4	DTR1 (Output - AT-60 Ready)
5	Ground

RS Interface Testing (cont.)

Test Input / Output

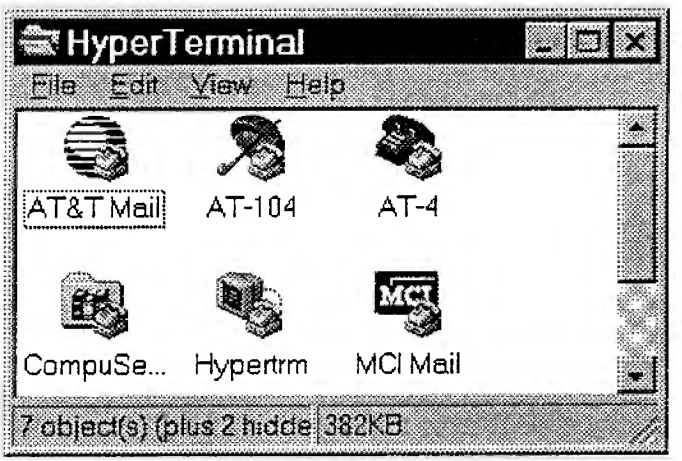
The test transmission / test reception options enables a test sequence to be generated and received. Use these test options to ensure that the receiving and transmitting units can communicate and that the cable assemblies, connectors etc. between the communicating units are good.

The test message generated is a string of all ASCII characters - ABCD.... 1234....abcd... etc. When the test transmission / reception option is selected, the string of characters sent by the transmitting unit are displayed on the LCD in the receiving unit. In the transmitting unit a message is displayed indicating that a test transmission is in progress.

To perform these tests, you will need a second SP-10 unit, or the SP-10 RS-232 (#3) interface has to be connected to an active terminal, for example the Hyperterminal, which is available under Windows 95™. The following equipment is needed:

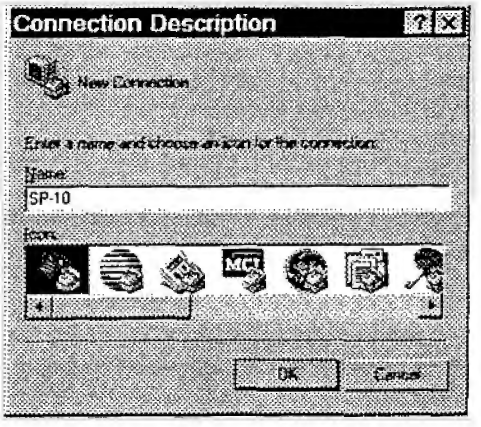
- A personal computer (PC) with Windows 95™ Hyperterminal installed.
- An RS-232 cable assembly, Art.No. 2.310 159, for connecting the RS-232 (#3) interface on the SP-10 with the COM port of the PC. This assembly consists of a cable, Art. No. 2. 310 094 and an adapter DB 9 / DB 24, Art. No. 2. 100 552.

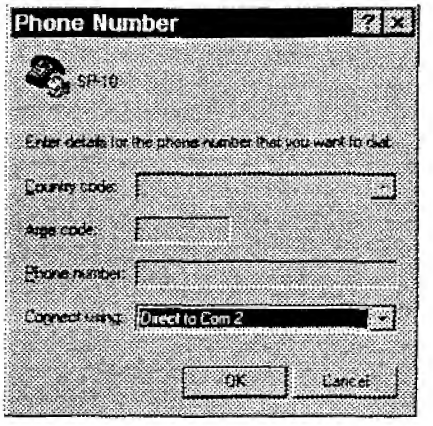
1. Start from Windows 95 desktop. Click on START. Select Programs / Accessories / Hyperterminal.



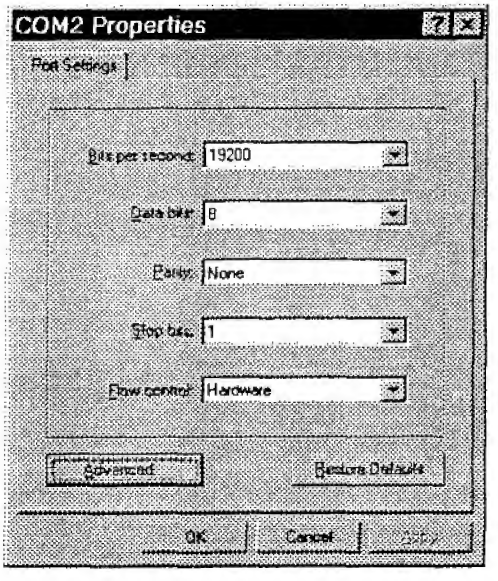
2. Double-click on Hypertrm(.exe). Enter the name SP-10 for the new connection and click on OK.

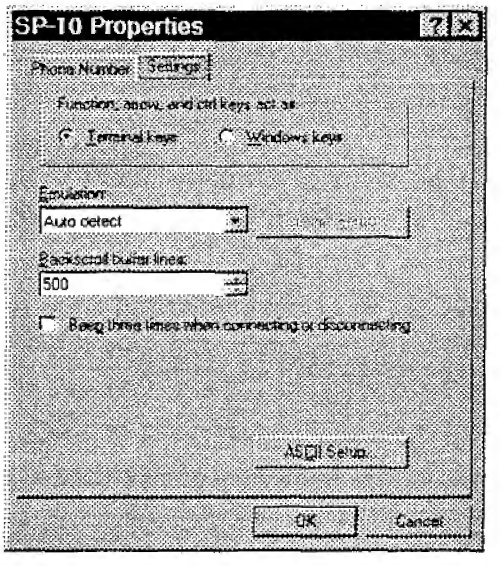
RS-232 Transmission/Reception Test





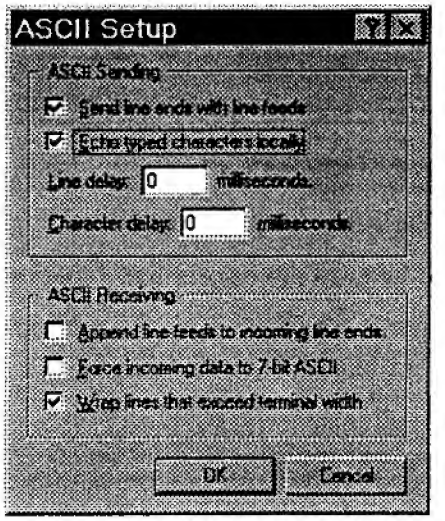
3. Set the direct connection to the proper COM-port and click OK.
4. Enter the port settings 19200, 8, N, 1, Hardware and confirm with OK..





5. You are now in the SP-10 Hyperterminal window. Click on File and select Properties.
6. Go to tab Settings and set Terminal keys, Auto detect and 500 buffer lines.
7. Click on ASCII Setup.

RS-232 Transmission/Reception Test (cont.)



8. Check the boxes for "Send line ends with line feeds", "Echo typed characters locally" and "Wrap lines that exceed terminal width". Confirm with OK. Click once more on OK to get back to the open Hyperterminal window.

You are now ready to start the input and output tests.

Test Output

- On the SP-10, press the <SETTINGS> key and select <5> RS-Test. Use the +/- keys to set the Baud rate to 19200, key <P> to set parity N and key <S> to set the stopbit to 1. Set Channel No. 3 with key <N>.

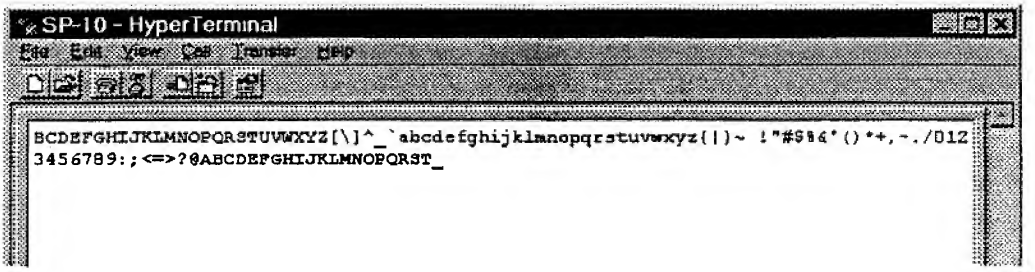
```
TEST RS-232 / 422

O  =  Test output on channel n
I  =  Test input on channel n
Q  =  End of test input/output
N  =  Channel selection
+/-/P/S  =  Settings
T  =  Selftest with test plug

CHANNEL n = 3      B: 19200  P: N  S: 1
DSR  BD  FE  OE  PE  TxE  RxR  TxR
 0    0   0   0   0   1    0    1
```

- Press key <O> (Output) "Test output on channel n" on the SP-10.
- The SP-10 now sends a string of alphanumerical characters, which are echoed in the Hyperterminal window on the PC.

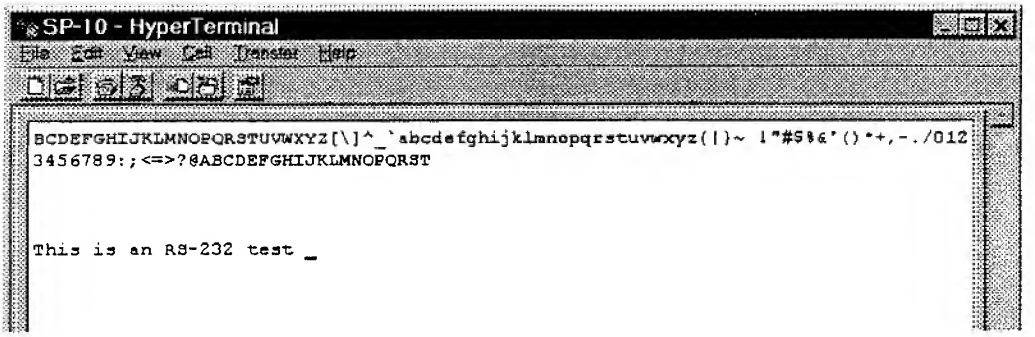
RS-232 Transmission/Reception Test (cont.)



- Stop the test by pressing key <Q> (Quit) 'End of test input/output'.

Test Input

- In the RS-232 test window, press the key <I> (Input) 'Test input on channel n'. The upper part of the RS-232 test window is erased to be able to display incoming messages.
- On the PC, type any characters and verify that they are echoed on the SP-10.



- Stop the test by pressing key <Q>. Leave the RS-232 test window by pressing ESC.

Error Codes

The error codes shown at the bottom of the display have the following interpretations:

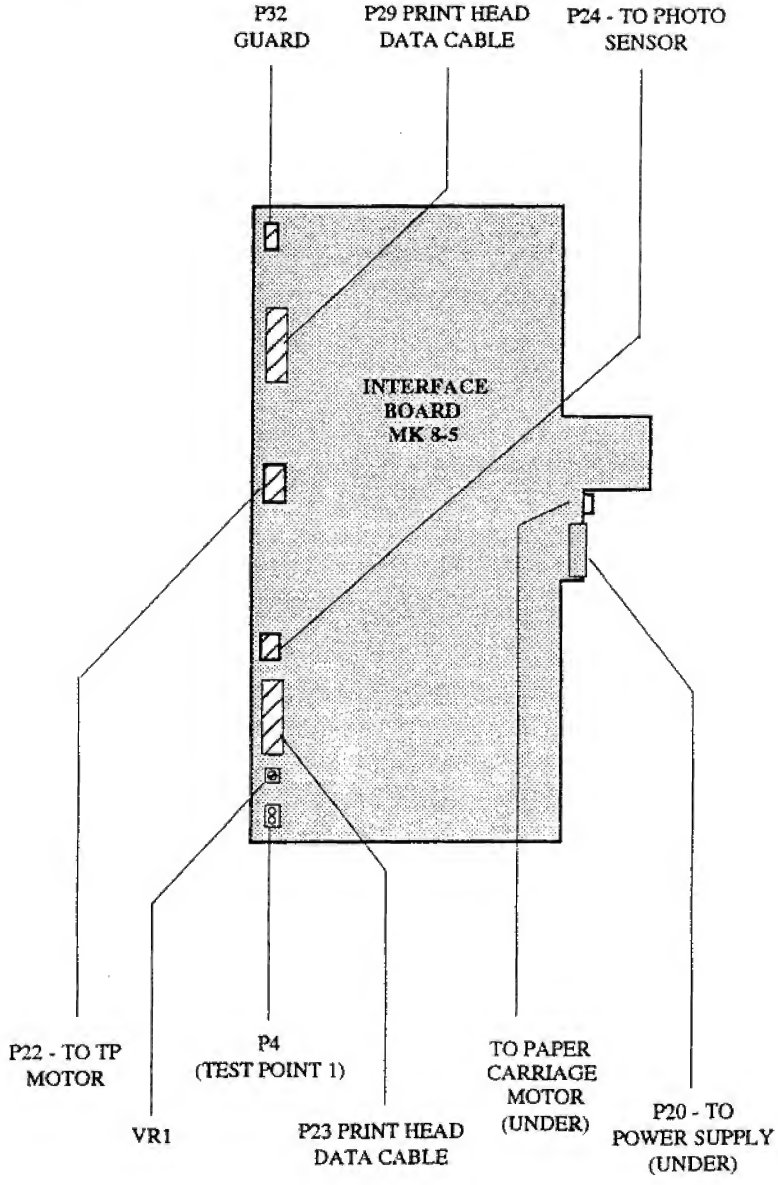
DSR	Data set ready
BD	Break detected
FE	Frame error
OE	Overrun error
PE	Parity error
TxE	Transmitter empty
RxR	Receiver ready
TxR	Transmitter ready

Interface Board Adjustments

One adjustment is possible on the Interface board - Paper Mark (VR1). This pre-set is used to adjust the paper mark detection circuit threshold so that the paper mark is recognised. The paper mark is used for calculation of print-out commencement position, paper detection, paper present etc.

Paper Jammed Indication

When the detection circuit does not recognise the paper mark, a paper jam error message may be displayed. Before carrying the paper mark adjustment procedure, ensure that the paper detector window is clean.



Interface Board MK 8-5

Interface Board Adjustments (cont.)

Paper Mark Adjustment

Set the paper mark threshold as follows:

1. Connect a digital voltmeter across the P4 connector (test point 1).
2. Switch the unit on and adjust VR1 to obtain a reading as follows:
   - > 3.5V when the black paper mark is under the paper mark detector
   - 0.4 to 0.5V when there is no paper mark under the detector ie white paper

NB IF THE DETECTION DOES NOT RECOGNISE THE PAPER MARK AFTER ADJUSTMENT, ENSURE THAT THE PAPER MARK WINDOW IS CLEAN.

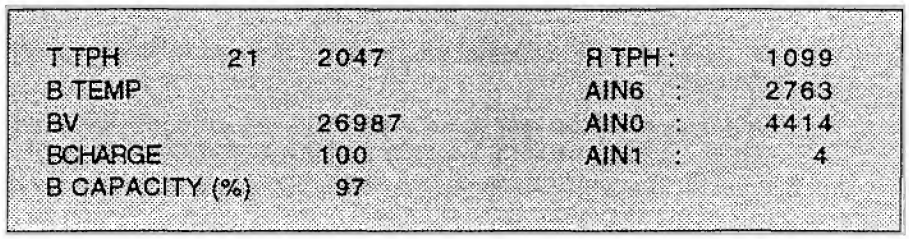
Service Screen and Printer Resistance Setting

The service screen provides readings of some of the internal offsets and also contains the thermal print head resistance setting option.

To enter the service screen press the settings key to display the Settings menu then press the letter T (for test)

<SETTINGS> <T>

The following display is shown:



This screen gives the following data and adjustments:

R TPH

The value indicated here is the resistance of the thermal print head and must be set to the correct resistance to ensure a good quality print-out. The print head resistance is found on a label on the printer.

To set the resistance of the thermal print head press </>. The first figure of the resistance value is now highlighted and the new resistance value can be entered. The entered value must be more than 1000 Ohms and less than 1800 Ohms. If a resistance value outside of these limits is entered, the user is prompted to enter the value again. When the resistance is set press <ENTER>.

T TPH

This displays the thermal print head temperature, and the thermal print head temperature in volts (received from the transducer).

B TEMP and AIN6

This displays the battery temperature, and the battery temperature in volts (received from the transducer).

BV and AIN0

BV indicates the voltage level of +US (that is the battery voltage, or the primary dc voltage generated by the power factor controller from the mains (and used for battery charging)). The actual voltage level of +US is calculated from the BATTV signal (sheet 5 of the power supply circuit diagram) and shown on this screen as AIN0. The value of BV is approximately 26.8V (nom +27V) when working from the mains, and between +24V and +21V when using battery power. The AIN0 indication (signal BATTV) is 4000mV±100 when working from the battery and 4400mV±100 when working from the mains

Service Screen and Printer Resistance Setting (cont.)

BCHARGE, AIN1 and B CAPACITY

AIN1 gives a voltage value indicating the loading control level of the battery (from the PSU - signal BATTLC). The voltage range is 0mV to 2500mV (0V indicates that the battery is fully charged, 2500mV indicates that the battery is fully discharged.

Because every battery varies, the processor initially calculates the capacity of the battery so that it knows when to generate the battery low signal - the B CAPACITY indication gives the calculated capacity of the installed battery. When a new battery is installed, it must be fully charged and fully discharged a minimum of two times, so that the processor can accurately assess the capacity of the new battery.

The BCHARGE indication shows the remaining battery capacity and is calculated from BATTLC signal (AIN1 indication).

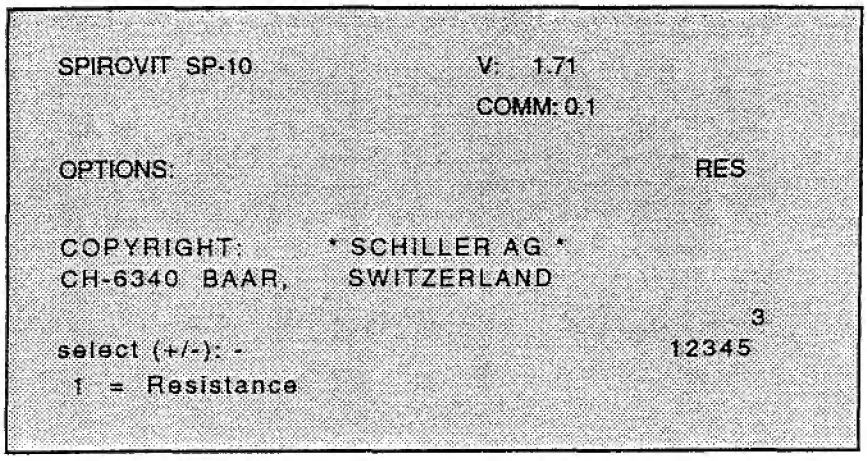
Note: The battery capacity displayed on the LCD information box is the actual remaining capacity of the battery and is calculated from B CAPACITY and AIN1. The remaining capacity displayed in the information box will not necessarily be the same as that shown for BCHARGE.

Unit Software

To check the software version of the unit and to display all the systems options that have been installed, press the setiings key followed by the letter x:

<SETTINGS> <X>

The software version and the installed options are displayed on the LCD as follows:



- The top line gives the equipment name and the overall system software version of the unit; that is the software version of the EEPROMs in the Program Pack. This is followed by a combination of characters to indicate the type of software (or basic options) that is installed.
- The second line gives the software version of the communications controller on the Processor Board - COMM: 0.1
- Below the software version details is the options line. This details the options that are installed. These are as follows:

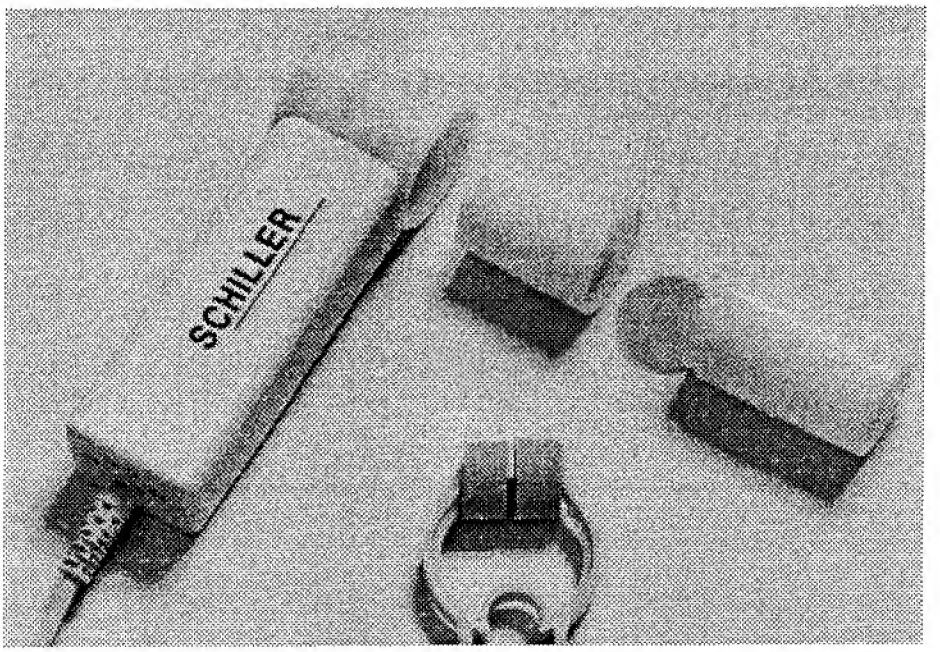
  ◊ RES - Lung Resistance

- The number below, and to the right of the Copyright notice, is a counter of the number of unauthorized attempts that have been made to incorporate extra options to the unit.

  Important - only 9 attempts are allowed and if this figure exceeds 9, no more upgrades are possible.

- The number immediately below the unauthorized attempts counter is the system serial number.
- The options on the bottom of the screen are the software updates that can be incorporated into the unit when the correct code is entered. To incorporate any of these software options the code must be entered, the option selected with the <+> and <-> keys and the <ENTER> key pressed. The code can be purchased from Schiller AG through your local dealer.

Replacing the Flow Sensor Filter



Spirometer SP-20 / SP-110 / SP-150

The filter is the only serviceable item on the flow meter. To replace the filter proceed as follows:

1. Remove and discard the mouthpiece.
2. Remove the rubber adapter by pulling it away from the inner tube.
3. Remove the inner tube of the flow sensor by pushing it out of the outer tube in the direction of the red location marks. Once the tube has been pushed half way it can be pulled out from the other side.
4. Unscrew the two halves of the inner tube and remove and discard the filter.
5. Clean and sterilize all parts of the inner tube, the rubber adapter and the inside of the outer tube with one of the following products:
   - ◊ Incidin GG
   - ◊ Amocid
   - ◊ Lysoformin
   - ◊ Alhydex
6. The cable and handle can be wiped with soapy water (do not dip into liquid!).

Replacing the Flow Sensor Filter (cont.)

7. Insert a new filter into the inner tube so that it sits on the inner lip of the half with the red location mark.
8. Carefully screw the two halves of the inner tube together making sure that the filter is not displaced.
9. Locate the end of the inner tube into the end of the outer tube and push it gently but firmly until the shoulder of the inner tube makes contact on the outside edge of the outer tube. The two red location marks must be in line.
10. Fit the rubber adapter by placing its wider end over the end of the inner tube with the red location mark.
11. Insert a new mouthpiece (max. 1.5cm) into the end of the rubber adapter.

Chapter 4
Physical Overview & Module Replacement

Contents

Physical Description

Introduction

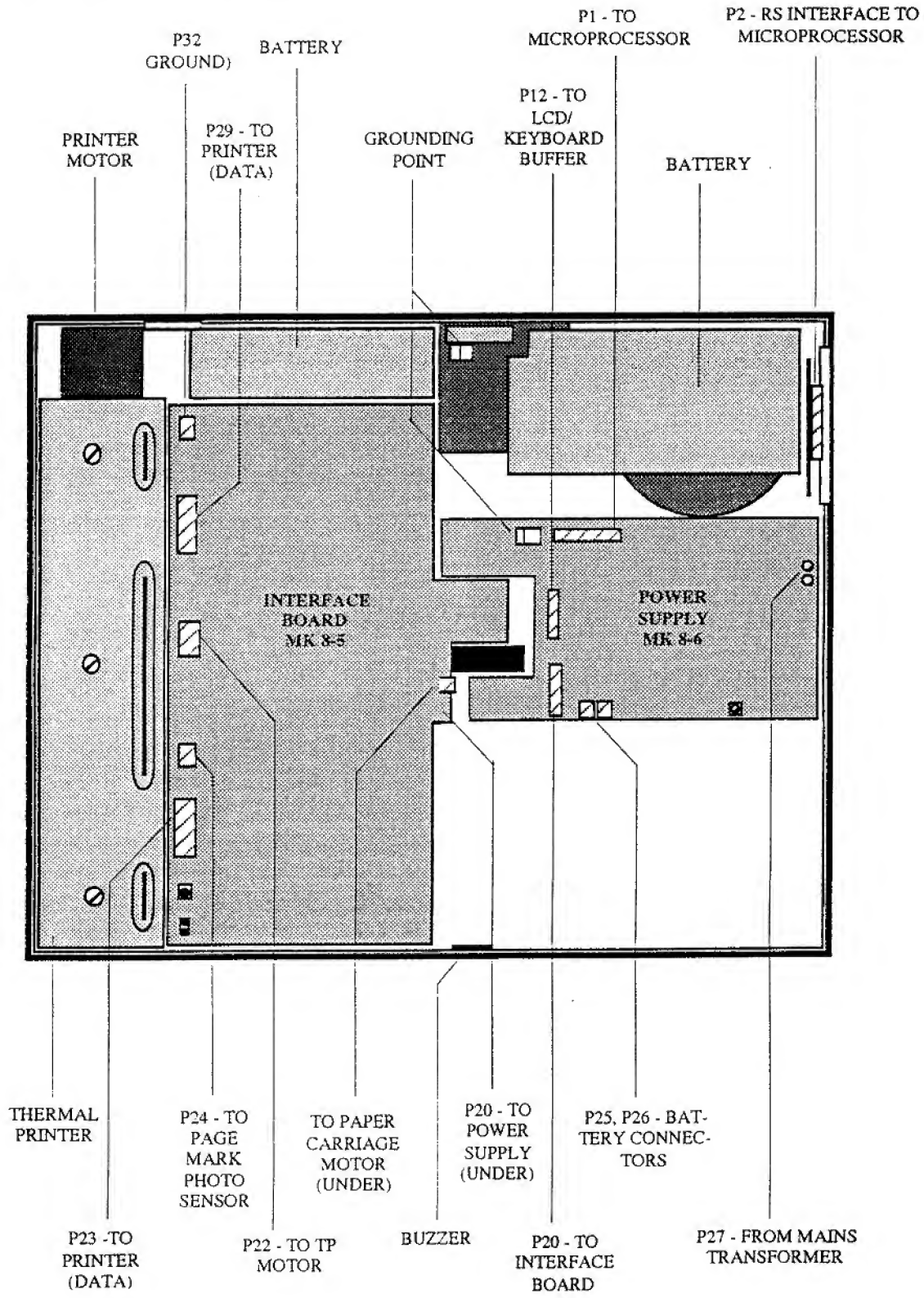
The SP-10 comprises two main assemblies as follows:

- The Base Assembly
- The Top Assembly

The Base Assembly contains most of the SP-10 electronics, and all external connectors. The Top Assembly houses the keyboard and the LCD display. The two assemblies are moulded to fit together and are secured with captive screws. Electrical connection between the two assemblies is achieved with a ribbon cable assembly.

Because of the plastic construction, threaded metal inserts are used for all screw fixings in the unit.

Physical Description (cont.)



Base Assembly

Physical Description (cont.)

Base Assembly

The base assembly comprises a moulded plastic tray onto which is mounted the following:

- ◊ Mains Isolation Transformer
- ◊ Two Lead-Acid Batteries
- ◊ Power Supply PCB MK 8-6
- ◊ Interface Board MK 8-5
- ◊ Microprocessor Board MK 8-1
- ◊ Program Pack MK 8-11
- ◊ Thermal Printer
- ◊ Paper Tray Assembly with Carriage Motor

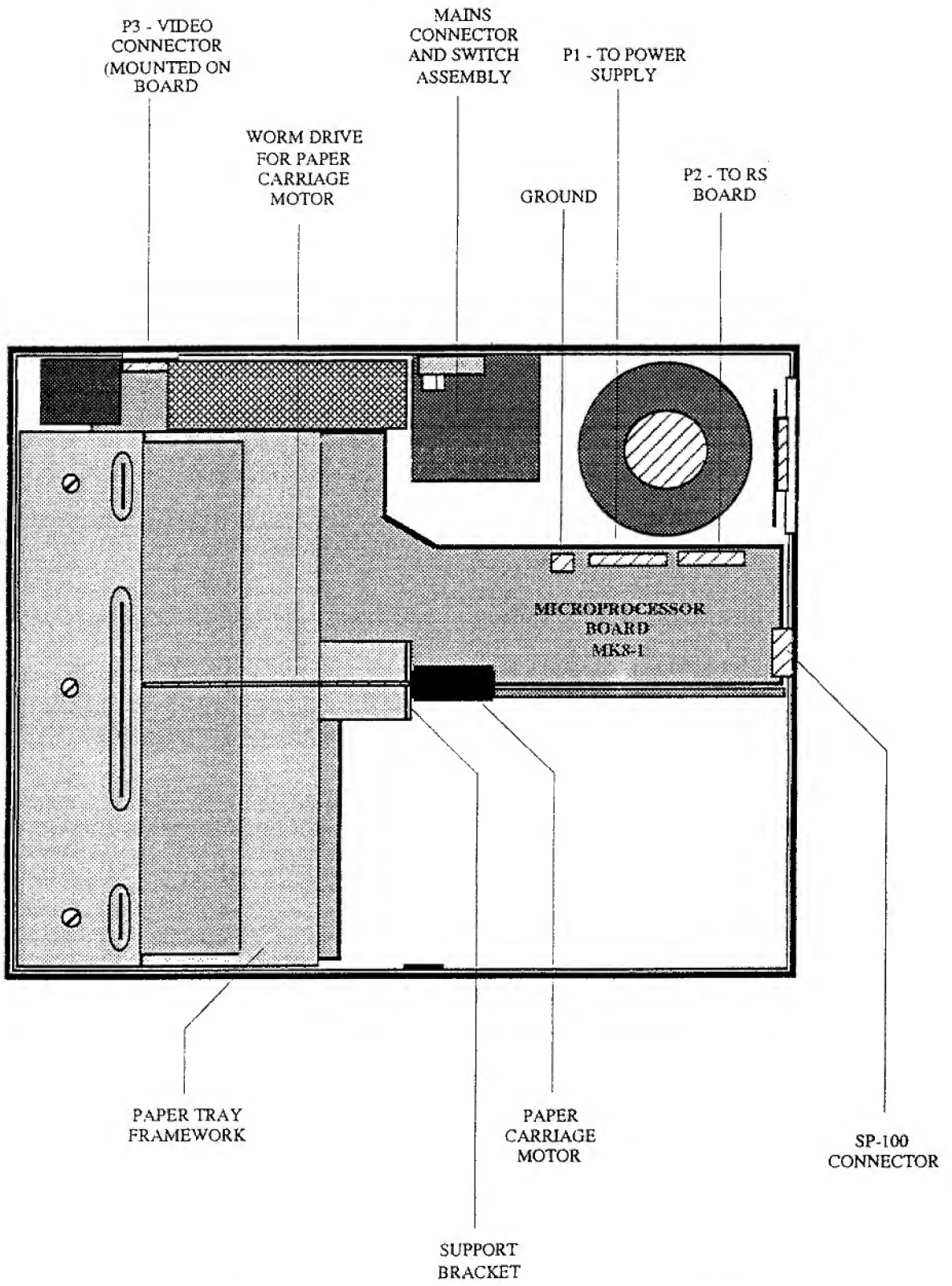
The Microprocessor Board is secured to moulded supports on the bottom of tray. The Power Supply is mounted on four spacers above the Microprocessor board and the Interface board and the thermal printer are mounted on the metal paper tray framework. Electrical connection between all boards is achieved with ribbon cable assemblies or with flying leads.

The Mains Connector and Switch assembly is secured to the Back Panel with spring loaded clips. The Mains Transformer is secured to the tray with a centre screw. Electrical connection between the Power Supply board, the Transformer, the Batteries, and the Mains Connector and Switch assembly, is achieved by flying leads.

The Program Pack is inserted via a cut-out in the side panel under the paper tray. It is mounted in slides and connects directly with the Processor Board. One captive screw secures the Program Pack in position.

Cut-outs in the back and side panels are provided for external connectors. The Video and Spiro (SP-110) connectors are all mounted directly on the Microprocessor board. All other connectors are mounted on dedicated mounting plates.

Physical Description (cont.)

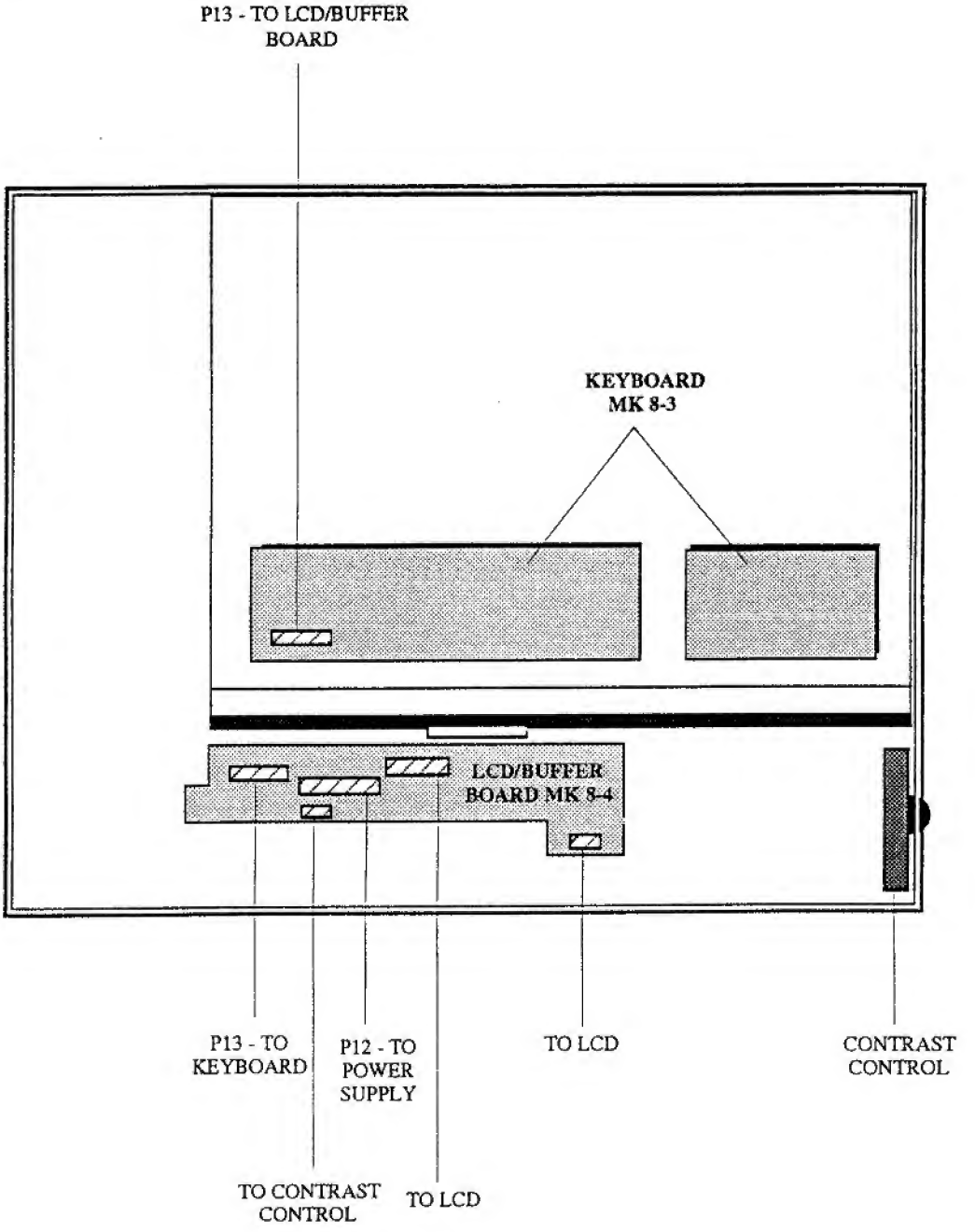


Base Assembly without Interface and Power Supply board.

Physical Description (cont.)

The metal paper tray framework allows the paper tray to be withdrawn. The dual rotation paper carriage motor turns a worm drive to slide the paper tray in or out.

Physical Description (cont.)



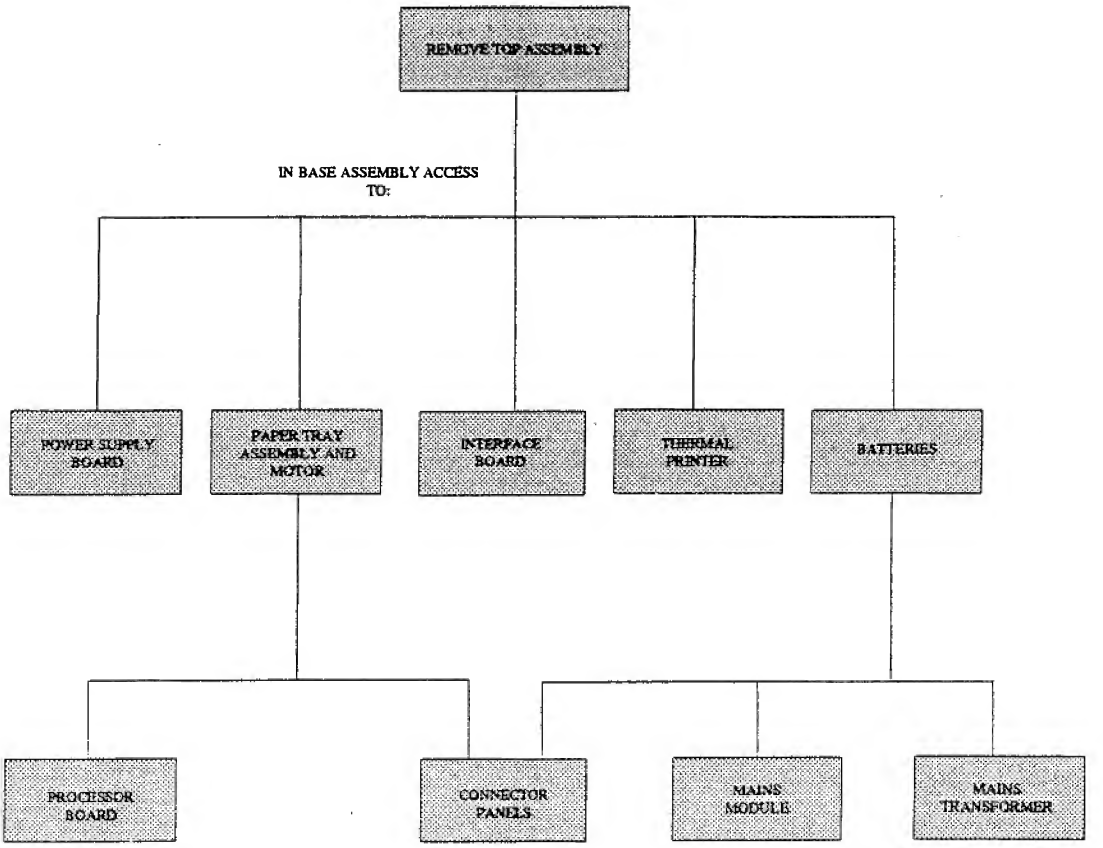
Top Assembly

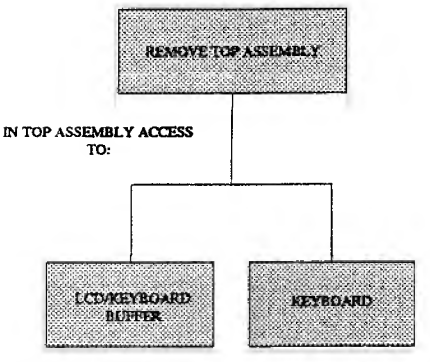
Physical Description (cont.)

Top assembly

The Top Assembly is manufactured from moulded plastic and comprises a Main Housing with a hinged LCD assembly.

Secured in the main housing is the LCD/keyboard Buffer MK8-4 and the Keyboard MK 8-3. Both of these boards are secured with double sided tape. Electrical connection between the modules is achieved with ribbon cable assemblies or with flying leads.





Note: Access to the Program Pack is gained via the left-hand Side Panel under the paper tray
Access to the mains fuse and the voltage selector is from the back panel (Mains Module).

Removal and Replacement

Introduction

This part provides the procedures to carry out the removal and replacement of all modules that are spared at service level. The instructions given in this chapter are autonomous, with each module containing the following:

- The pre-requisites that must be fulfilled before removal of the module
- Tools and equipment that are required to remove and replace the module and to carry out the functional checks and adjustments.
- Removal Procedures
- Replacement Procedures
- Checks and Tests that must be carried out after replacement.

Any adjustments, jumper settings, special checks or functional procedures that are required during a procedure, are detailed in the relevant step.

In-text diagrams support the text where required and provide location details of connectors, test points and adjustment potentiometers.

Specific warnings and cautions are given where applicable. Warnings indicate potential danger that could cause personal injury. Cautions indicate areas that could cause damage to the equipment .

If a key operation or menu selection is required, the key sequence required is given in parenthesis `<>´. The character (or character string) given in parenthesis is the actual character that is printed on the key. When a key sequence is provided it must be followed in the order given. For example the key sequence to display the time and date screen is as follows:

<SETTINGS> <1>

This requires that the settings key on the keypad is pressed, followed by the number 1 key.

Safety Notices

WARNINGS

BEFORE COMMENCING ANY REMOVAL OR REPLACEMENT PROCEDURES ENSURE THAT THE MAINS POWER SUPPLY IS SWITCHED OFF AND THAT THE MAINS CABLE IS REMOVED.

CERTAIN CHECKS AND ADJUSTMENTS CAN ONLY BE CARRIED OUT WITH THE TOP ASSEMBLY REMOVED AND WITH MAINS CONNECTED. WHEN CARRYING OUT THESE PROCEDURES BEWARE THAT POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

CAUTIONS

THE SP-10 CONTAINS STATIC SENSITIVE CMOS COMPONENTS; OBSERVE ANTI-STATIC PRECAUTIONS:

◊ WHEN CARRYING OUT ANY MAINTENANCE PROCEDURES ALWAYS PLACE THE UNIT ON AN EARTHED ANTI-STATIC MAT.

◊ PERSONAL MUST BE EARTHED WHEN HANDLING ANY BOARDS OR COMPONENTS

◊ ALWAYS USE AN ANTI-STATIC BAG WHEN TRANSPORTING BOARDS OR COMPONENTS

THE UNIT IS SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING, ALWAYS PLACE THE UNIT ON A SOFT, NON-ABRASIVE CLOTH WHEN CARRYING OUT MAINTENANCE PROCEDURES

TAKE CARE NOT TO PLACE ANY STRAIN ON THE CONNECTING RIBBON CABLE WHEN REMOVING THE TOP ASSEMBLY. ENSURE THAT THE CABLE ASSEMBLY IS NOT CRIMPED OR TWISTED AND THAT THE TOP ASSEMBLY IS NOT PLACED ON THE CABLE ASSEMBLY.

CARE MUST BE TAKEN WHEN REMOVING AND REPLACING CONNECTORS. NEVER USE FORCE. NEVER STRAIN THE CABLE ASSEMBLIES.

THE PROCEDURAL STEPS GIVEN FOR EACH MODULE MUST BE FOLLOWED IN THE ORDER GIVEN.

Opening the case

Pre-requisites

- The unit must be placed on an anti-static mat and anti-static precautions observed when any maintenance is carried out on the SP-10. The room temperature should be between 18 and 28 degrees.
- Mains supply is required to carry out the unit functional test after assembly.

Tools

- Posi-drive screwdriver

Test Equipment

The following test equipment is required to carry out the functional test after unit assembly

- Flow Sensor Spirometer SP-110
- Calibration pump
- RS Test Cable (supplied by Schiller)

Top Assembly Removal

The Top Assembly is mounted on the Base Assembly and is secured to the Base Assembly with six screws and washers; access to the screws is gained from the underside of the unit. To remove the Top Assembly, proceed as follows:

1. Remove all cable assemblies connected to the side and rear panels. Ensure that the mains cable is removed.
2. Taking care to secure the hinged LCD module so that it cannot swing open, turn the unit up-side-down and rest on a soft cloth.
3. Unscrew the six retaining screws and washers situated in the extreme corners and edges of the unit, indicated by an arrow.
4. Grasping the top and bottom of the unit to ensure that the two assemblies cannot part, carefully return the unit to the standing position.
5. Gently lift the Top Assembly sufficiently to gain access to the interconnecting cables, and disconnect the connector from the Power Supply Board and the ground connector.
6. Gently lift the Top Assembly away from the Base Assembly and place on a soft cloth.

Top Assembly Replacement

To replace the Top Assembly proceed as follows:

1. Check that all boards and components are firmly secured. Check for loose screws. Ensure that no screws or foreign bodies are loose in the bottom of the case.
2. Inspect all the internal cable assemblies and ensure that they are in good condition and that no visible damage can be seen. Ensure that no cable assemblies are strained, crushed or caught.
3. Ensure that all connectors are firmly home.

Opening the case (cont.)

4. Position the Top Assembly adjacent to the Base Assembly and without straining the ribbon cable, plug in the interconnecting cable from the Top Assembly to the Power Supply (P12). Reconnect the ground cable from the keyboard.

   Note: It may be necessary to tilt the Top Assembly for the cable assemblies to reach.

5. Carefully position the Top Assembly on the Base Assembly.

6. Grasping the two assemblies to ensure that they cannot part, carefully turn the unit up-side-down and replace the six securing screws and washers in the extreme corners and edges of the unit. Return the unit to the upright position.

Functional Check After Assembling the SP-10

The procedure detailed here is a general confidence check in the unit after an internal module or board has been replaced. It is not a full functional test but is intended to provide a general confidence check after a module has been replaced. To carry out the check proceed as follows:

1. Ensure that the voltage selector on the back panel is set for the required voltage and connect mains to the unit. Switch on the mains and ensure that the green mains LED lights.

2. Switch the unit on by pressing the <ON> key on the Keyboard. Ensure that the LCD lights and that for a few seconds the test screen is displayed at the bottom of the screen. When the test screen disappears, check that the welcome display is given and that the date and time are shown in the data box in the right hand corner of the LCD.

3. Press <SETTINGS> <1> and enter the time and date details. Press <FNCT> when complete. Ensure that the correct date and time is displayed on the screen.

4. Connect the flow sensor SP-110 to the connector on the right hand panel of the unit. Connect a calibration pump to the sensor.

5. Press the <CALIBRATION> key. Enter the ambient temperature and press <ENTER>. Press <START> and empty the calibration pump[1]. Press <ENTER> and at the prompt 'Effective Vol', enter the calibrated volume of the pump, in litres.

   [1]Note:To obtain a more accurate calibration, it is recommended that the calibration pump is emptied more than once to achieve a total volume of more than 6 litres.

6. Repeat step 5 and ensure that the measured volume is correct.

7. Press the <PATIENT DATA> key and systematically press the keys:

   <QWERTYUIOP>, <ENTER>, <1234567890>

   Ensure that the entered data is correctly presented on the screen as entered. Press <FNCT> to exit the patient data display.

8. Select a test key (eg <FCV E>) and press <START>. With the calibration pump, or manually blow into the flow sensor. Ensure that the pulmonary graph is traced on the screen and that after six seconds the unit prompts for the second reading.

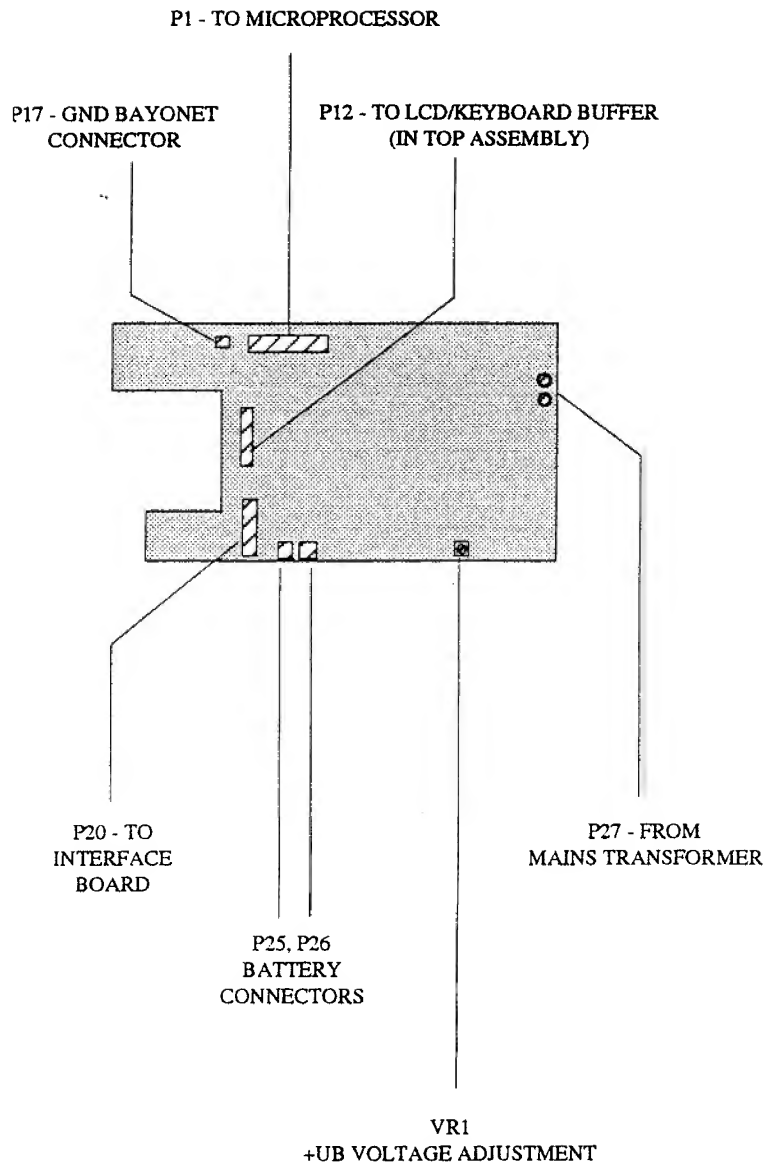
Opening the case (cont.)

9. Press the <PRINT ALL> or <PRINT BEST> key and ensure that the print-out is accurate and of good quality.

   Note: If the print-out quality is poor and the printer has not been changed, the stored printer resistance data may have been lost from memory. To check the stored resistance setting see paragraph 'Service Screen' in chapter 3. If problems are experienced with paper mark detection or setting the printer speed it may be necessary to adjust the factory pre-sets on the Interface board.

10. If a module has been replaced carry out the checks and tests detailed in the relative Paragraph (if not already carried out). Switch the unit off and leave connected to the mains supply for 24 hours to fully charge the battery.

Power Supply board



Power Supply Board MK 8-6

Power Supply board (cont.)

The Power Supply board is positioned on four spacers above the Processor board.

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Tools and Equipment

- Cross-Bladed screwdriver
- Small flat-bladed screwdriver
- Digital Voltmeter

In addition if the Power Supply board is checked in isolation, a Power Supply capable of supplying up to 30V, is required.

Parts

- Power Supply MK 8-6. Part number as detailed in Chapter 5.

Power Supply Board Removal

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

To remove the Power Supply board proceed as follows:

1. Disconnect the flying leads to the mains transformer and to the batteries. Disconnect P20 to the Interface board, P1 to the Microprocessor and the GND guard P17. (P12 to the LCD/ Keyboard Buffer MK 8-4 will already be removed).
2. Unscrew the four screws securing the board to the spacers and remove the board

Power Supply Board Replacement

To replace the Power Supply proceed as follows:

1. Position the board on the spacers and secure with the four securing screws.
2. Connect the Mains Transformer leads and the battery leads. Connect P1, P20 and P17 (GND).

Checks and Tests after Power Supply Board Replacement

After assembly, connect the mains supply to the unit and ensure that the green mains supply LED is lit. Switch the unit on and ensure that the LCD is lit and that meaningful data is displayed. Press the <SETTINGS> key followed by key <P>.. Ensure that the printer functions.

Check that the battery charge monitor circuit is functioning as follows:

Power Supply board (cont.)

1. Switch the unit off but leave the mains connected. Leave the battery to charge for 10 hours. Check that the battery light flashes when the battery is charging and extinguishes when the battery is fully charged (after a maximum time of 15 hours).
2. Disconnect the mains and run the unit on battery power for 60 minutes (without using the printer). Check that:
   - ◊ the battery LED lights when running on battery power
   - ◊ the battery LED flashes when the battery capacity is low
   - ◊ the unit switches off when the battery capacity falls below a preset value

Note: Control of the Battery LED is from the CPU which uses the counter signal (BATTLC) to calculate the charge state of the battery. If the Battery LED is not giving the expected indications, the fault may lie on the Processor board (or P1 connector). The signal to control the battery LED is LEDB.

The nominal battery capacity at which the Battery Low is active (LED flashing) is 25%. The nominal voltage at which the Battery down signal is active and the unit switches off, is 21V.

Checking the Power Supplies

The power supply voltages can be checked without the SP-10 being assembled. However the Power Supply board is easily accessible and it is usually easier to check the power supplies with the unit assembled and the Top Assembly positioned by the side. If the board is to be checked in isolation a latch circuit must be manually set to switch on the power supply (equivalent to pressing the <ON> key).

Test points are provided on the Power Supply board for measurement of all power rails.

Individual adjustment is not possible for any of the voltage rails except +UB (from which all other supplies are generated and the batteries are charged). Note that +UB can only be adjusted with mains connected.

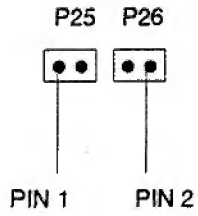
ON Signal Simulation

If the Power Supply board is checked in isolation the ON line must be connected to GND to latch the power supply on. To simulate the ON signal, proceed as follows:

Note: The ON simulation signal is only required when the ON key on the keypad, cannot be used to switch the power supply on, that is when P12 to the Top Assembly is disconnected.

Power Supply board (cont.)

1. Connect power to the Power Supply board as follows:
   - ◊ If the unit is assembled, use either mains (via the mains transformer) or two fully charged batteries connected to the battery connectors
   - ◊ If the unit is not assembled, connect a power supply to the battery connectors on the Power Supply board. Connect the positive to pin 1 of plug P25, and the negative to pin 2 of plug P26. Set the Power Supply to 24V.



2. Using a suitable lead, connect GND to Plug P12 pin 25, and hold for 2 seconds. The power supply will now be latched on and all generated power supplies can be checked for the correct voltage.

Note: To switch the power supply off, connect 0V to P1 pin 50.

+UB Adjustment

This adjustment sets the voltage supplied from the switching regulator on the mains power factor controller circuit. To adjust this voltage the unit must be assembled and mains connected.

WARNING

LETHAL VOLTAGES ARE PRESENT WHEN CHECKING AND ADJUSTING THE POWER SUPPLY. DO NOT LET CONCENTRATION LAPSE. EXERCISE GREAT CARE WHEN TAKING MEASUREMENTS.

To check and adjust +UB supply proceed as follows:

1. Connect mains power to the unit and switch on by pressing the <ON> key on the keyboard.
2. Measure the voltage at P25 pin 1. Adjust VR1 to achieve a voltage of +27V ±200mV.

Power Rail Measurement

No adjustment is possible for any of the power rails. To check the power rail voltages go on the relevant test point (component layout given at the end of this book) and measure with a DVM. If any of the values are out of tolerance first ensure that +UB voltage is correct. If this is correct the power supply must be changed.

Lead-acid Batteries

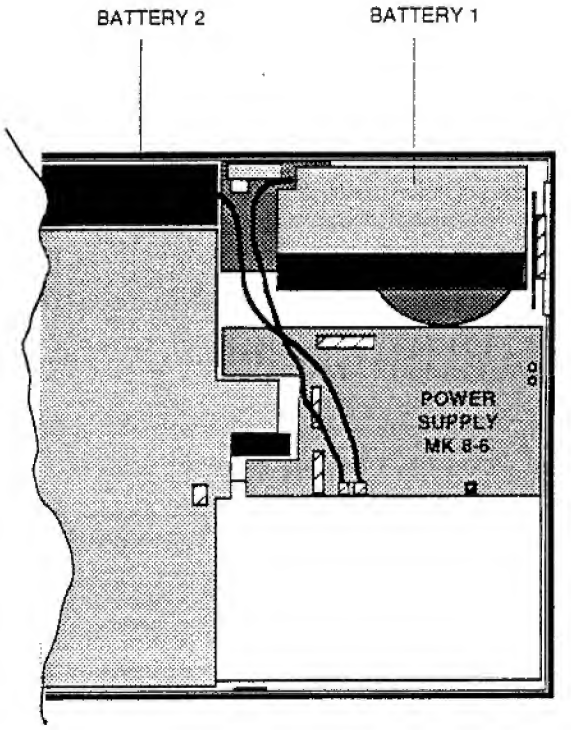
Two batteries are installed in the SP-10. They are self contained with integral leads and connectors.

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Parts

The part numbers of all replaceable items are given in Chapter 5.



Battery Removal

WARNING

THE MAINS SUPPLY MUST BE DISCONNECTED DURING THIS PROCEDURE

To remove the battery proceed as follows:

1. Ensure that the unit is switched off and that the mains is disconnected. Remove all cable assemblies connected to the front and rear panels.
2. Disconnect the battery connectors from the Power Supply board and remove the batteries.

Lead-acid Batteries (cont.)

Battery Replacement

To replace the battery position the battery and connect the leads to the battery connector on the Power Supply.

Note: Red lead is the + battery terminal
Black lead is the - battery terminal

Checks and Tests After Battery Replacement

To ensure that the battery and the battery recharging circuit are functioning after battery replacement, proceed as follows:

1. Connect mains to the unit and ensure that the green mains and the yellow battery indicators, next to the display, are lit. Charge the battery for approximately 15 hours.
2. Ensure that the Battery indicator is extinguished after 15 hours (battery fully charged).
3. So that the capacity of the newly installed battery is calculated correctly by the processor, run the unit on battery power until the battery is fully discharged and the unit switches off. Repeat this process two times. This ensures that the correct capacity of the battery is registered by the processor. The calculated value of the battery capacity can be seen by pressing:

   <SETTINGS> <T>

   The B CAPACITY (%) indication displays the calculated battery capacity. See Chapter 3 for further details.
4. Program all static settings which will have been lost when the battery was disconnected.

Interface Board

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Tools

- Cross-bladed screwdriver
- Small flat-bladed screwdriver

Parts

- Interface Board MK 8-5. Part number as detailed in Chapter 5.

Interface Board Removal

To remove the Interface Board disconnect all connectors, unscrew the four screws securing the board to the Paper Tray Assembly, and lift the board away from the Paper Tray Assembly.

Interface Board Replacement

The replace the Bus Interface position the board on the Paper Tray Assembly and secure using the four captive screws. Reconnect all connectors to the Thermal Printer and the Power Supply.

Checks and Tests After Interface Board Replacement

The paper mark detection offset must be checked. To set the paper mark threshold proceed as follows:

1. Connect a digital voltmeter across the P4 connector (test point 1).
2. Switch the unit on and adjust VR1 to obtain a reading as follows:
   - > 3.5V when the black paper mark is under the paper mark detector
   - 0.4 to 0.5V when there is no paper mark under the detector ie white paper

NB IF THE DETECTION DOES NOT RECOGNISE THE PAPER MARK AFTER ADJUSTMENT, ENSURE THAT THE PAPER MARK WINDOW IS CLEAN.

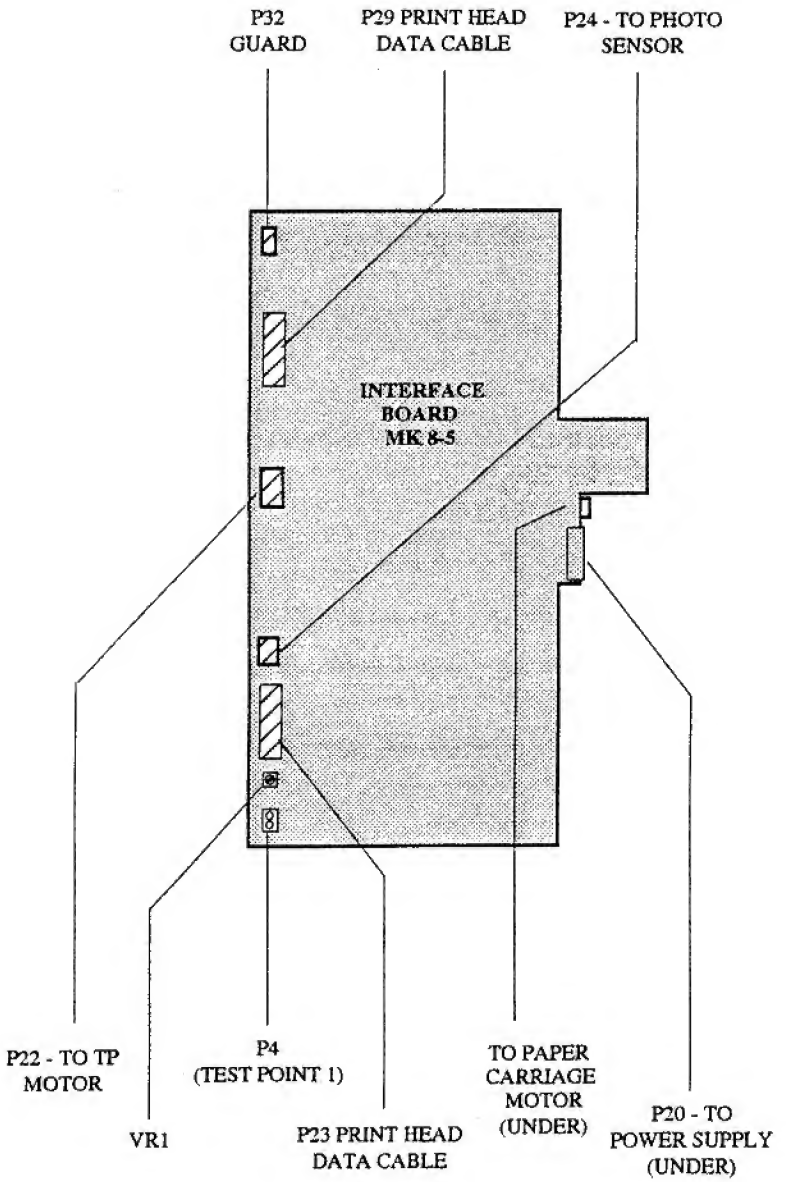
3. Carry out the printer check to ensure that the board is functioning correctly . Enter the following key sequence:

<SETTINGS> <P>

Interface Board (cont.)

A print-out of a series of diagonal lines will be given. Examine the print-out and ensure that all the lines are even and uninterrupted. Ensure that the complete paper is covered with close diagonal lines and that no blocks of plain paper are present. Any faulty print-head pixels will be seen as a horizontal white line. Examine the print-out for evenness of print.

Note: Unevenness of print or faulty individual pixels indicates a problem with the printer or printer alignment. If a complete block is left unprinted it additionally indicates that the Interface board could be faulty or the fault lies with the printer data control circuits on the Processor board.



Paper Tray Assembly

The Paper Tray Assembly comprises a metal framework onto which is mounted the paper tray and motor, the thermal printer and the interface board. It is positioned above the Processor board and is mounted on four spacers.

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Tools

- Cross-Bladed Screwdriver
- Flat-Bladed Screwdriver

Parts

- The part number for the Paper Tray Assembly, complete with the DC motor is given in Chapter 5.

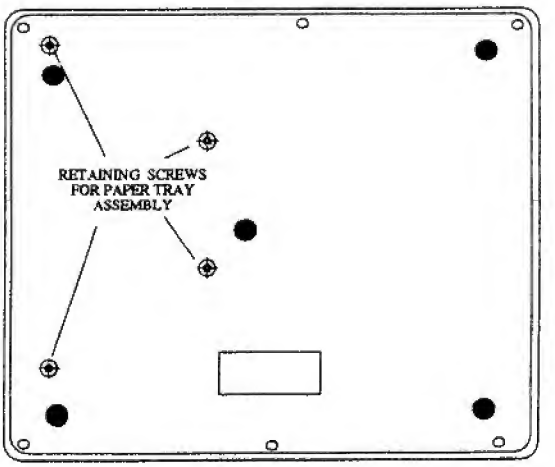
WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

Paper Tray Removal

To remove the Paper Tray Assembly proceed as follows:

1. Remove P20 on the Power Supply.
2. Carefully turn the unit upside down and rest it on a soft cloth. Remove the four screws retaining the paper tray assembly.
3. Hold the two parts together and turn them right side up. Watch for screws falling out !
4. Taking care not to damage the printer motor gently ease the complete Paper Tray Assembly away from the unit.



Paper Tray Assembly (cont.)

Paper Tray Replacement

To replace the Paper Tray Assembly proceed as follow:

1. Gently ease the assembly in position on the four spacers above the Processor board.
2. Hold the two parts firmly together and turn upside down. Secure the four screws retaining the Paper Tray Assembly to the Base Assembly.
3. Turn right side up and replace P20 on the Power Supply.
4. Replace the Top Assembly as detailed earlier.

Checks and Tests after Paper Tray Assembly Replacement

After assembly connect mains to the unit and ensure that the green power LED lights. Press the <REPLACE PAPER> key and ensure that the paper tray retracts smoothly. Check the printer by entering enter the following key sequence:

<SETTINGS> <P>

A series of diagonal line will be printed. Ensure that the print-out is even.

Microprocessor Board

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.
- The Power Supply board and the paper tray assembly must be removed before removing the Processor board.

Tools

- Cross-Bladed screwdriver

Parts

- Microprocessor Board MK 8-1. Part number as detailed in Chapter 5.

Microprocessor Board Removal

The Microprocessor board is secured to the Base Assembly with screws. To remove the Microprocessor Board proceed as follows:

CAUTION

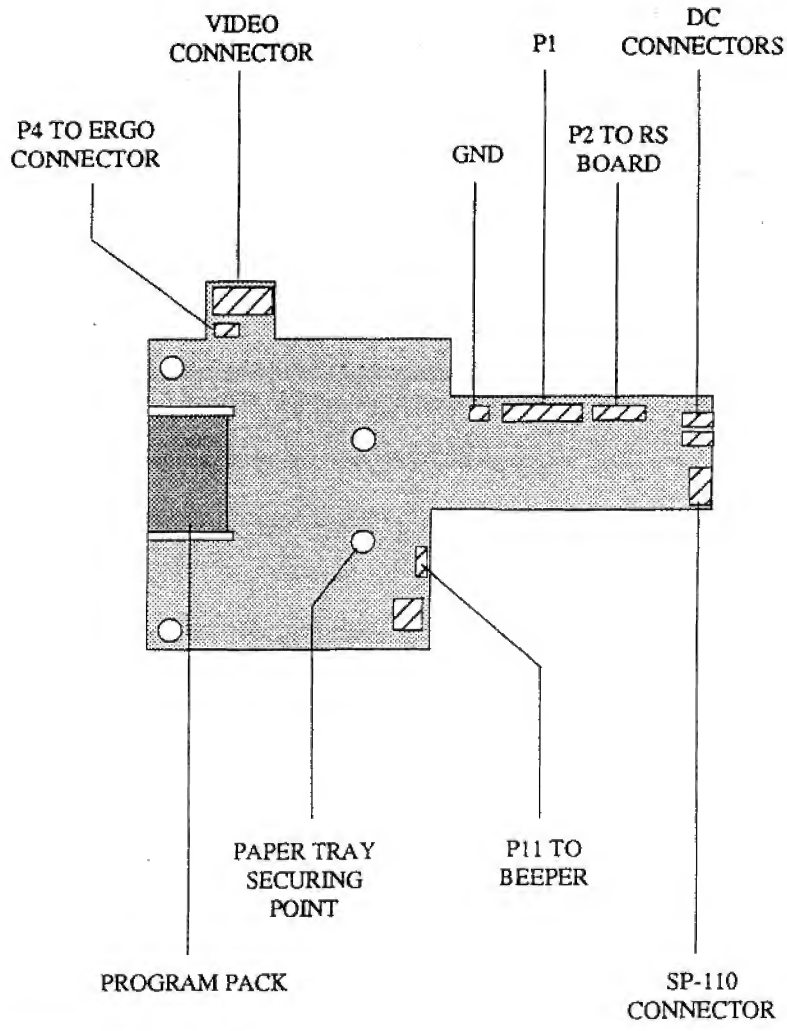
THE MICROPROCESSOR BOARD CONTAINS CMOS COMPONENTS. ANTI-STATIC PRECAUTIONS MUST BE OBSERVED AT ALL TIMES.

---

1. Remove the Top Assembly.
2. Remove the Power Supply board.
3. Remove the Paper Tray Assembly.
4. Remove the Program Pack.
5. Disconnect the following connectors from the Microprocessor board:
   - P4 to the ERGO connector on the back panel
   - P2 to the RS connectors on the Back Panel
   - P11 to the Beeper Connector
   - GND
6. Unscrew and remove the ten Microprocessor board securing screws and remove the Microprocessor Board.

Note: The Program Pack is mounted in slides on the Microprocessor board and connects directly with it.

Microprocessor Board (cont.)



Microprocessor Board Replacement

To replace the Microprocessor board proceed as follows:

1. Position the Microprocessor board in the Base Assembly and secure with the ten securing screws.
2. Reconnect the following connectors to the Microprocessor board:
   - P4 to the ERGO connector on the back panel
   - P2 to the RS connectors on the Back Panel
   - P11 to the Beeper Connector
   - GND

Microprocessor Board (cont.)

3. Slide in, and secure the Program Pack as detailed below.
4. Replace the Paper Tray Assembly.
5. Replace the Power Supply board.
6. Replace the Top Assembly.

Checks and Tests After Microprocessor Board Replacement

When the unit is reassembled after Microprocessor board replacement, the functional check detailed in the beginning of this Chapter must be carried out to ensure the integrity of the assembled unit.

The capacity of the battery is calculated and stored by the processor for reference. To recalculate and store the correct battery capacity proceed as follows:

1. Fully charge the battery by leaving the unit connected to the mains for 15 hours.
2. Run the unit on battery power until the battery is fully discharged and the unit switches off.
3. Repeat this process two times.

The value of the battery capacity calculated (and stored) by the processor, can be seen by pressing:

<SETTINGS> <T>

The B CAPACITY indication displays the calculated battery capacity. See Chapter 3 for further details.

Program all static settings.

Program Pack (and Software Modules)

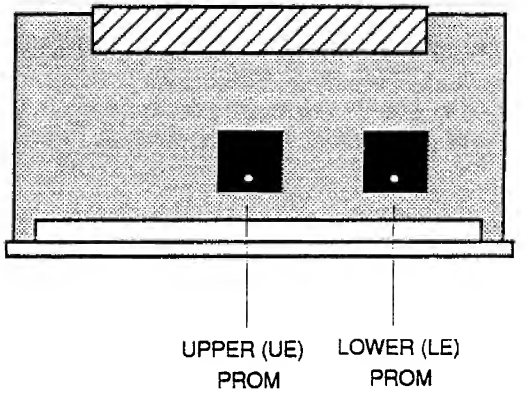
Pre-requisites

Tools

- 2mm hexagonal key (Allen Key).

Parts

- Program Pack. Part numbers as detailed in Chapter 6.



Note: The EEPROM software is available in various languages indicated by the label on the EEPROM. The second letter in brackets indicates the language as follows:

E - English

D - German

S - Swedish

I - Italian

F - French

P - Spanish

Program Pack (and program EEPROM) Removal

The Program Pack is mounted in slides secured on the Processor board. Access to the Program Pack is gained from the side panel under the Paper Tray.

CAUTION

THE PROGRAM PACK CONTAINS STATIC SENSITIVE CMOS COMPONENTS. OBSERVE ANTI-STATIC PRECAUTIONS.

Insert a 2mm hexagonal Allen key into the program pack holding screw aperture and unscrew until the program pack is pushed out. Gently ease the Program Pack away from the unit.

Program Pack (cont.)

Program Pack Replacement

Note: The software version of a program EEPROM chip is written on the label attached to the chip. Before replacing a program pack ensure that it is the correct software version for the application.

To replace the Program Pack, gently slide the pack in the board guides. Ensure that the program pack is square and use a 2mm hexagonal Allen key to pull in the program pack and secure.

Checks and Tests After Program Replacement

1. Switch the unit on by pressing the <ON> key on the Keyboard for approximately a second. Ensure that the LCD lights and that for a few seconds the test screen is displayed at the bottom of the screen. When the test screen disappears, check that the welcome screen is displayed and that the information box in the top right-hand corner of the display, is present.

2. Switch the unit on and check that the correct software version, as stated on the label is installed. To do this press the key sequence:

   <SETTINGS> <X>

   The software version is displayed on the LCD. (See Chapter 3 for software details). Check that all the options required are installed.

3. Carry out the SP-10 functional check detailed at the beginning of this chapter.

Mains assembly

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.
- The batteries must be removed.

Tools

- Narrow, blunt instrument for unlatching the assembly catches.
- Small flat-bladed screwdriver

Parts

- Mains Assembly. Part number as detailed in Chapter 5.

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

Mains Assembly Removal

To remove the assembly proceed as follows:

1. Disconnect the crimped flying lead connectors on the back of the assembly.
2. Using a narrow blunt instrument, unlatch the two bottom retaining catches. Unlatch the top catch and remove the assembly from the Mains Assembly securing bracket on the Base Assembly.

   Note: The Mains Assembly is retained in position with three tensioned catches. Access to the two bottom catches is gained from the bottom of the Base Assembly via two access holes.

Mains Assembly Replacement

1. Ensure that the mains voltage selector is set to the correct voltage for the application as indicated by an arrow in the selector and fuse sub-assembly. If the voltage is not set for the required voltage, proceed as follows:

   ◊ Using a small flat-bladed screwdriver gently prise the selector and fuse sub-assembly away from the main assembly.

   ◊ Lift the retaining clip securing the voltage plate and remove the plate.

   Note: The plate has contacts which are pushed into tensioned connectors; a small screwdriver may be required to prise the plate away from the connectors.

   ◊ Replace the voltage plate by pushing fully home. Ensure that the correct voltage is displayed in the front and top `voltage windows´.

   ◊ Click the sub-assembly back in place in the Mains Assembly.

Note: The fuse sub-assembly containing the mains fuses, is positioned under the voltage plate and is removed and replaced in the same way as above.

Mains assembly (cont.)

CAUTION

IT IS POSSIBLE TO INSERT THE MAINS ASSEMBLY UPSIDE DOWN. WHEN REPLACING THE ASSEMBLY ENSURE THAT THE MAINS ON/OFF SWITCH IS UPPERMOST WITH THE MAINS CONNECTOR UNDER THE ON/OFF SWITCH.

2. Push the Mains Assembly into the Base Assembly until the catches engage with the bracket. Ensure that the assembly is firmly in position.

3. Reconnect the crimped cables.

Checks and Tests after Replacement

After assembly connect mains to the unit and ensure that the green power LED lights.

LCD / Keyboard Buffer MK 8-4

The LCD/Keyboard Buffer board is situated in the Top Assembly adjacent to the Keyboard. It is secured in position with three retaining screws. The DC-AC Converter board (part of the LCD assembly) is soldered to the LCD/Keyboard Buffer board.

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Tools

- Cross-bladed screwdriver

Parts

- The part number for the LCD/ Keyboard Buffer Board MK 8-4 are given in Chapter 5.

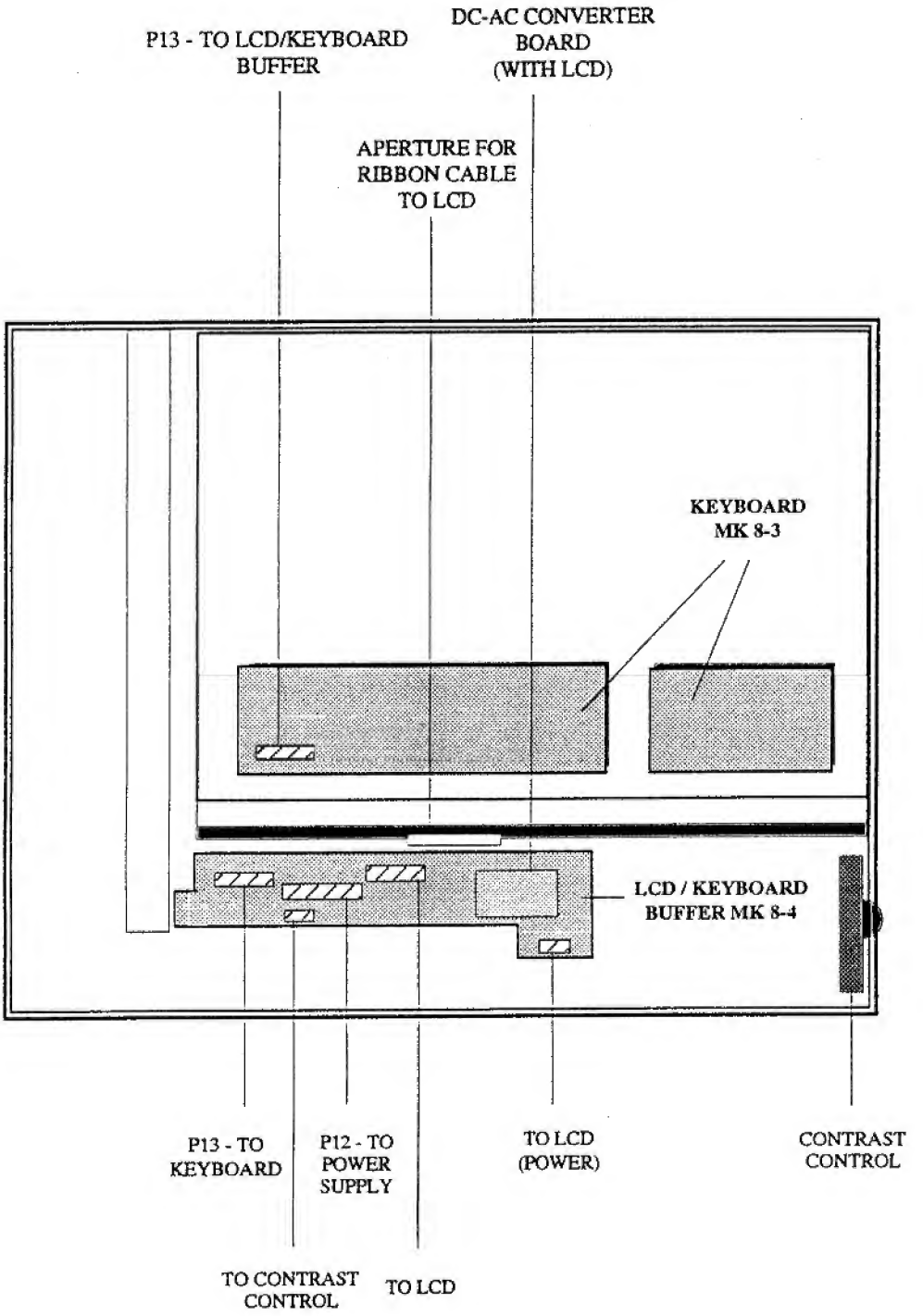
WARNING

HIGH VOLTAGES ARE GENERATED IN THE LCD. ENSURE THAT THE MAINS IS DISCONNECTED.

CAUTION

THE LCD/KEYBOARD BUFFER BOARD CONTAINS STATIC SENSITIVE CMOS COMPONENTS. OBSERVE ANTI-STATIC PRECAUTIONS.

LCD / Keyboard Buffer MK 8-4 (cont.)



LCD / Keyboard Assembly

LCD / Keyboard Buffer MK 8-4 (cont.)

LCD/Keyboard Buffer Removal

To remove the LCD/Keyboard Buffer proceed as follows:

1. Disconnect all connectors from the board.
2. Remove the three retaining screws and gently ease the board away from the case.

LCD/Keyboard Buffer Replacement

To replace the LCD/Keyboard Buffer board proceed as follows:

1. Position the board and secure with the three screws.
2. Connect all connectors.

Checks after Replacement

1. After assembly, connect mains to the unit and switch on. Ensure that the mains LED lights.
2. Switch the unit on and ensure that the LCD lights and that the welcome screen is displayed. Ensure that the `information box´ in the top right hand corner of the display is clearly defined and that all characters are correctly formed.
3. Enter the patient data screen by pressing <PATIENT DATA> and systematically press each of the keyboard characters. Check the LCD and ensure that the correct characters are displayed as entered.

Mains transformer

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.
- Battery 1 must be removed.

Tools

- Flat-Bladed screwdriver

Parts

- Mains Transformer. Part number as detailed in Chapter 5.

WARNING

ENSURE THAT THE MAINS CABLE IS DISCONNECTED BEFORE COMMENCING

Mains Transformer Removal

To remove the Mains Transformer proceed as follows:

1. Disconnect the four power supply bayonet connectors on the Power Supply board.
2. Disconnect the flying lead connectors to the Mains Assembly.
3. Unscrew the centre screw of the Mains Transformer, and remove from the Base Assembly.

Mains Transformer Replacement

To replace the mains transformer proceed as follow:

1. Position the Transformer and secure to the Base Assembly with the centre screw.
2. Connect the flying leads to the Power Supply and to the Mains Assembly. (See the Power Supply paragraph and Mains Assembly paragraph respectively, for the connector colours).

Checks and Tests after Replacement

After assembly connect mains to the unit and ensure that the green power LED lights.

LCD

The LCD comprises the LCD screen, a contrast control and an DC/AC Converter PCB (mounted on the LCD/Keyboard Buffer). The LCD is secured in position with double sided tape.

Pre-requisites

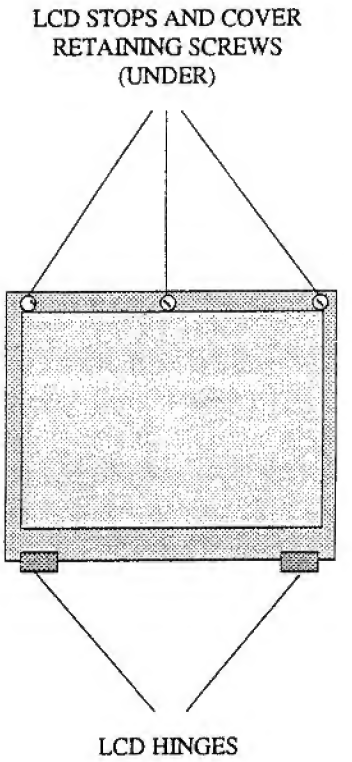
- The replacement of the LCD must be carried out under clean room conditions.
- The Warnings and Cautions at the beginning of the Chapter must be observed.

Tools and Disposables

- Cross-Bladed Screwdriver
- Long shafted cross-bladed screwdriver
- Flat-bladed blunt knife
- Anti-static cleaning fluid (alcohol based) and clean cleaning cloth

Parts

- The part number for the LCD assembly is given in Chapter 5.



LCD (cont.)

LCD Removal

To remove the LCD proceed as follows:

WARNING

HIGH VOLTAGES ARE GENERATED IN THE LCD. ENSURE THAT THE MAINS IS DISCONNECTED BEFORE REMOVING THE LCD HOUSING COVER.

1. Using a flat-bladed knife or a small screwdriver remove the three LCD stops on the top of the LCD to gain access to the screws securing the LCD housing cover.
2. Unscrew the three screws and gently ease the cover away from the LCD hinges at the bottom.

CAUTION

THE RIBBON CABLE TO THE LCD DOES NOT HAVE A CONVENTIONAL PLUG AND IS INSERTED DIRECTLY INTO THE SIDE OF THE CONNECTOR ON THE LCD. TAKE CARE NOT TO DAMAGE THE RIBBON CABLE CONTACTS WHEN REMOVING THE RIBBON CABLE. TAKE SPECIAL CARE WHEN REPLACING THE CABLE ASSEMBLY.

3. Lift the retaining tape from the LCD connector on the back of the LCD and remove the ribbon cable to the LCD/Buffer Board.
4. Very gently and evenly prise the LCD away from the case until it is free. Take care not to strain the ribbon cable.
5. On the LCD/keyboard buffer board remove the connector to the DC-AC Converter PCB and the connector to the contrast control. Remove the LCD.
6. Remove the two retaining screws securing the contrast control to the Top Assembly.

LCD (cont.)

LCD Replacement

To replace the LCD proceed as follows:

1. Ensure that the LCD recess is clean and free from grease, dirt, and any traces of adhesive. Use a clean cloth and alcohol based cleaning agent to wipe the recess to ensure a good adhesion surface.
2. Position the LCD in the casing and thread the ribbon cable and the power cable through the aperture in the Top Assembly casing.
3. Join the connectors at the back of the LCD and carefully tape to the LCD.
4. Using a flat-bladed knife peel off the protective backing from the two sided tape on the LCD and secure the LCD Assembly in the LCD recess.
5. Taking care not to touch the plastic screen, position the cover in the LCD bottom hinges and secure with the three retaining screws at the top. Replace the LCD stops in the screw recesses.
6. Using a flat-bladed knife peel off the protective backing from the two sided tape on the DC-AC Converter PCB and secure in position on the LCD/Keyboard Buffer.
7. Secure the contrast control with the two retaining screws.
8. Replace the connectors to the LCD/Keyboard Buffer and secure the cable to the housing with the cable clips. Secure the ribbon cable with retaining tape.

Checks after LCD Replacement

1. After assembly, connect mains to the unit and switch on. Ensure that the mains LED lights.
2. Switch the unit on and ensure that the LCD lights and that the welcome screen is displayed. Ensure that the `information box´ in the top right hand corner of the display is clearly defined and that all characters are correctly formed.
3. Enter the patient data screen by pressing <PATIENT DATA> and systematically press each of the keyboard characters. Check the LCD and ensure that the correct characters are displayed as entered.

Thermal Printer and Print Head (cont.)

Thermal Printer Replacement

The resistance value of the printer is used as an off-set by the printer drive circuit and must be entered via the SP-10 menu structure, prior to operation. Before replacing the printer, make a note of the printer resistance. The resistance value is found written on a label on the printer.

To replace the Thermal Printer proceed as follows:

1. Position the Printer and secure with the four corner retaining screws. Ensure that the cable assemblies from the printer to the Interface PCB are not caught and are not strained.
2. Reconnect the connectors to the Interface board

Checks, Tests and Adjustments after Printer Replacement

Carry out the printer check as follows:

1. Check that the correct resistance of the printer is entered in the SP-10 memory as follows:

   Note: The printer resistance will be found on a label attached to the printer.

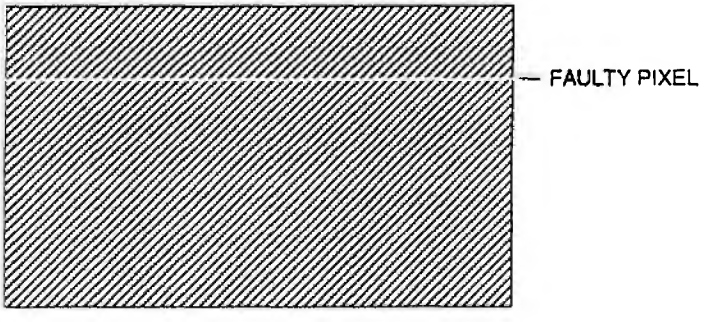
   ◊ Enter the following key sequence <SETTINGS> <T>

   ◊ R TPH is the resistance of the printer. To enter a new resistance value press </>(slash key). The first figure of the resistance value is highlighted and the correct resistance value can be entered. Press <ENTER> when the correct resistance has been entered. Note that the SP-10 will only accept a resistance range of between 1000 and 1800 Ohms.

2. To check the printer and to ensure that every pixel is operational enter the test screen and press P. Enter the following key sequence:

   <SETTINGS> <P>

A print-out of a series of diagonal lines will be given. Carefully examine the print-out and ensure that all the lines are even and uninterrupted. Any faulty print-head pixels will be seen as a horizontal white line. Examine the print-out for evenness of print. If the print intensity is uneven (for example darker at the top than the bottom), check the alignment of the printer and adjust the tension of the print head (print head tensioning screws) to obtain the best print-out.



Keyboard

Pre-requisites

- The Warnings and Cautions at the beginning of the Chapter must be observed.
- The Top Assembly must be removed and all external cable assemblies disconnected.

Tools and Materials

- Wide, blunt instrument eg screwdriver handle (for applying an even pressure to the board during removal).
- Clean lint free cloth
- Cleaning agent such as alcohol or trichorethylene

Part Numbers

The part number for the keyboard PCB is given in Chapter 6.

Keyboard Removal

The Keyboard is secured in position with double side adhesive tape. To remove the keyboard proceed as follows:

1. Taking care to secure the hinged LCD module so that it cannot open, turn the Top Assembly up-side-down.

CAUTION

THE TOP ASSEMBLY IS SUSCEPTIBLE TO ABRASION DAMAGE. TO PREVENT SCRATCHING PLACE THE TOP ASSEMBLY ON A NON-ABRASIVE CLOTH WHEN UP-SIDE-DOWN.

---

2. Remove the keyboard connector from the LCD/Keyboard Buffer PCB.

CAUTION

TO PREVENT DAMAGE TO THE TOP ASSEMBLY HOUSING, DO NOT ATTEMPT TO PRISE THE KEYBOARD FROM THE FRONT OF THE UNIT.

---

3. From the bottom of the assembly, through the housing aperture, apply pressure to the Keyboard with a blunt instrument, until the keyboard lifts.

   Note: If difficulty is experienced in removing the Keyboard leave the unit switched on for an hour with the LCD screen down. This should provide sufficient heat to loosen the keyboard adhesive and make it easier to remove.

4. When the keyboard has lifted, return the Top Assembly to the upright position and remove the Keyboard from the recess.
5. Using a clean cloth and a cleaning agent wipe the Keyboard recess to remove any traces of adhesive or dirt that may prevent good adhesion.

Keyboard (cont.)

Keyboard Replacement

The Keyboard comes complete with double sided adhesive tape for fixing the board in position. To replace a keyboard proceed as follows:

1. Ensure that the Keyboard recess is clean and free from grease, dirt, and any traces of adhesive. Use a clean cloth and a cleaning agent to wipe the keyboard recess to ensure a good adhesion surface.
2. Remove the protective backing from the adhesive tape, precisely position the board and gently place in position. When the Keyboard is correctly positioned, use a clean cloth to firmly press down on the keyboard to ensure good adhesion.
4. Turn the Top Assembly up-side-down and connect the keyboard connector to the LCD/ Keyboard Buffer board.
5. Leave for five hours to allow the keyboard to bond with the unit.

Checks after Replacement

1. After assembly, connect mains to the unit and switch on. Ensure that the mains LED lights.
2. Switch the unit on and ensure that the LCD lights and that the welcome screen is displayed. Ensure that the `information box´ in the top right hand corner of the display is clearly defined and that all characters are correctly formed.
3. Enter the patient data screen by pressing <PATIENT DATA> and systematically press each of the keyboard characters. Check the LCD and ensure that the correct characters are displayed as entered.

Chapter 5
Spare Parts

Contents

Introduction

This Chapter gives the part numbers for modules that can be replaced by the service engineer. The part numbers for disposables, accessories and dedicated test equipment are also included.

When ordering state that the module required is for an SP-10 unit and provide the following:

- Part Title
- Part Number
- Software Version *
- Serial number of the unit *
- Your company address and a contact name

* The software version and the serial number of the unit are found on the software screen (details in Chapter 4). The serial number is especially necessary when ordering mechanical parts to ensure that the correct version is identified by the processing department.

Additionally if you are returning a faulty module the following information, in as much detail as possible, will speed repair:

◊ the exact nature of the fault

◊ the circumstances, and function being carried out, when the fault occurred

IT IS RECOMMENDED THAT RETURNED MODULES ARE SENT BY REGISTERED POST.

IMPORTANT

ALL BOARDS AND STATIC SENSITIVE MODULES MUST BE RETURNED IN A SEALED STATIC SHIELDING BAG. NO RESPONSIBILITY CAN BE ACCEPTED FOR MODULES NOT SENT IN THIS WAY

The address to send your order is:

Schiller AG

Sales Department (Order Processing)

Altgasse 68

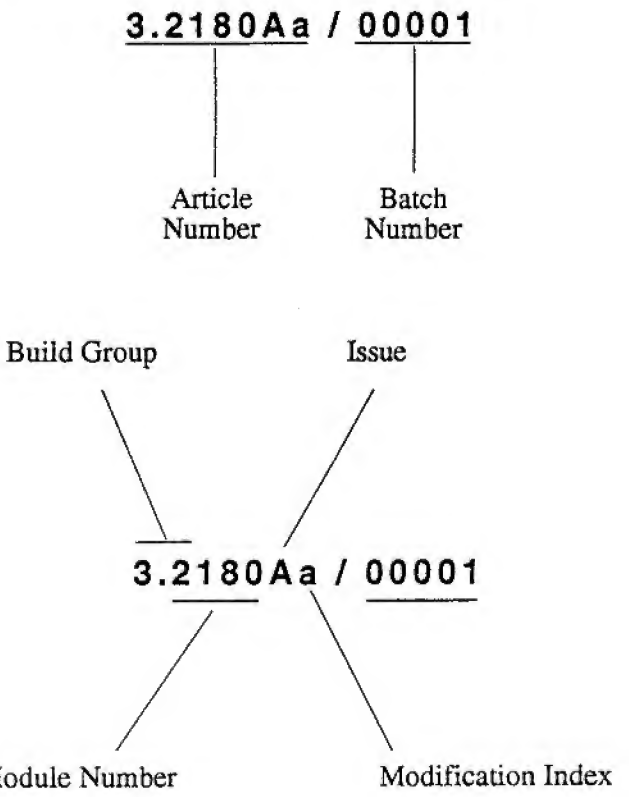
CH-6340 Baar

Switzerland

Introduction (cont.)

Module Identification

Every module has a unique part number. The number is either stencilled on the module or printed on an attached label. The module numbers are arranged as follows:



When ordering a module, only the article number has to be stated (without the modification index). The Batch number is a manufacturing identification number and need not be stated unless a module is suspected of having a manufacturing fault.

The article number is divided as follows:

Build Group Number	This number identifies the type of module or module group, for example electrical (PCB), mechanical, component etc.
Module Number	The individual module number
Issue Letter	This is always an upper case letter and gives the issue state of the module
Modification Index	This lower case letter gives the modification or build state of the module. It is applicable only for the specific Issue

Introduction (cont.)

The documentation associated with a module, is identified by a letter in place of the module build group number. For example the processor board for the AT-60 ECG unit without the Spirometry option, has the article number **3.2180Ga.**

The Circuit Diagram is **S.2180Ga,**

The Block Diagram is **B.2180Ga**

The Component Layout is **D.2180Ga.**

The categories are as follows:

DOCUMENT	IDENTIFICATION LETTER
CIRCUIT DIAGRAM	S
BLOCK DIAGRAM	B
COMPONENT LAYOUT	D
TEST DOCUMENTATION	P
ASSEMBLY DOCUMENTATION	F

Note that the Test Documentation and Assembly Documentation is usually available for internal use only.

SP-10 Spare Modules

DESCRIPTION	PART NUMBER
PAPER MARK DETECTOR MK 8-51C	3. 2247CA
MICROPROCESSOR BOARD SP-10 MK 8-1D	3. 2231DB
PROGRAM PACK MK 8-11C	3. 2241CA
CONNECTORS RS 232/422 MK 8-7C	3. 2239CB
POWER SUPPLY BOARD MK 8-6E	3. 2238EF
INTERFACE BOARD MK 8-5E	3. 2237EA
LCD/KEYBOARD BUFFER MK 8-4C	3. 2236CC
KEYBOARD SP 8-3D GERMAN	3. 2290DA
KEYBOARD SP 8-3D ENGLISH	3. 2291DA
KEYBOARD SP 8-3D FRENCH	3. 2292DA
KEYBOARD SP 8-3D ITALIAN	3. 2293DA
PAPER TRAY DC MOTOR (COMPLETE)	3. 910 610
THERMAL PRINT HEAD	4. 140 113
THERMAL PRINTER MOTOR	3. 910 609
LCD 640 X 480	4. 600 064
LEAD ACID BATTERY	4. 350 020
MAINS MODULE (COMPLETE)	4. 270 004
MAINS TRANSFORMER	4. 320 112

Disposables

DESCRIPTION	PART NUMBER
PRINTER PAPER	2. 157 012
DISPOSABLE CARDBOARD MOUTHPIECES (FOR PNEUMOTACHO SENSOR SP-110 , 100 PCS)	2. 100 024

Accessories

DESCRIPTION	PART NUMBER
GROUND CABLE	2. 310005
POWER CABLE,USA (STRAIGHT)	2. 300001
POWER CABLE, CH (ANGULAR)	2. 300003
POWER CABLE, UK (ANGULAR)	2. 300004
POWER CABLE, D (ANGULAR)	2. 300005
PNEUMOTACHO SENSOR SP-110 SET	2. 200510
PNEUMOTACHO SENSOR SP-20	2. 200540
PNEUMOTACHO SENSOR SP-150	2. 200520
FILTERS (FOR SP-110)	2. 100026
CALIBRATION PUMP 2 LITRE	2. 100027

Dedicated Test Equipment and Special Tools

DESCRIPTION	PART NUMBER
RS TEST CABLE ASSEMBLY 3-WAY CONNECTORS	2. 310 042
2MM HEXAGONAL KEY FOR THE REMOVAL /REPLACEMENT OF THE PROGRAM PACK	STANDARD TOOL AVAILABLE ON THE MARKET
HEXAGONAL CROSS-BLADED SCREWDRIVER USED FOR THE REMOVAL AND REPLACEMENT OF THE PRINT HEAD	SCHILLER NUMBER 4.950074. MANUFACTURED BY WERA, NUMBER - WERA 367 TX 210180

Chapter 6
Technical Data

Contents

Technical Data

General

Dimensions (l/w/h):	320 x 264 x 74 mm
Weight:	approx. 4.7 kg
Power supply requirements:	110 / 130 / 220 / 240Vac, 50 / 60Hz
Power consumption:	13 to 30VA
Battery:	lead-acid, 2 x 12V
Printing process:	high-resolution thermal printhead, 8 dots per mm (amplitude axis), 40 dots per mm (time axis) @ 25mm/s
Paper speed:	2.5 / 5 / 10 / 12.5 / 25 / 50 / 100 mm/s
Chart paper:	thermoreactive, Z-folded, perforation for A5 format
Liquid crystal display:	Backlighted liquid crystal display for ECG monitoring and alphanumeric information
	Resolution: 480 x 640 dots; viewing angle adjustable
Protection class:	I according to IEC
Environmental conditions:	temperature, operating: 10° to 40 °C
	temperature, storage: 0° to 50°C
	relative humidity: 15 to 85 % (non-condensing)
Keyboard:	splashproof keys

Pulmonary Function

Method of Measurement:		pneumotachometer
Measurement Ranges:		Flow: 0 to ± 14 l/s;
Volume:		0 to ± 11 litres
Measurement Accuracy:		± 2%
Flow Impedance:		less than 0.5 mbar * s/l at 10 l/s
Measured Values:		VC, ERV, IRV, TV, FVC, $FEV_{0.5}$, $FEV_{1.0}$, $FEV_{3.0}$, $FEV_{0.5}$/VC, $FEV_{1.0}$/VC, $FEV_{3.0}$/VC, $FEF_{0.2-1.2}$ (litres), $FEF_{25-75\%}$, $FEF_{75-85\%}$, PEF, $MEF_{75\%}$, $MEF_{50\%}$, $MEF_{25\%}$, MV, MVV, FIVC, $FIV_{1.0}$, $FIV_{1.0}$/FIVC, $FIV_{1.0}$/FVC, PIF, $MIF_{50\%}$.
		Comparison pre/post medication possible.
Prediction Equation:	Adults:	ECCS / Berglund / Finnish / Indian / Morris / Crapo / Knudson
	Children:	Quanjer & Tammeling / Indian / Knudson

Technical Data (cont.)

Accessories for Pulmonary Function Testing

Standard Accessories	Pneumotacho sensor SP-110
	Disposable cardboard mouthpieces
	Nose clips
	Filter
Optional Accessories	Calibration pump

Video Connector

Type:	D sub, 15 pole, High-density, female:	
Resolution:	640 x 480 dots	
Input signals:	horizontal sync.:	TTL (positive)
	vertical sync.:	TTL (negative)
	video:	0 to 0.7V
Scanning frequency:	horizontal:	31.3 kHz
	vertical:	60 Hz
Pin Connections:	Pin 2	Video
	Pin 11	DISP
	Pin 5	Test
	Pin 13	H-SYNC
	Pin 7	Video GND
	Pin 14	V-SYNC
	Pin 9	D CLK
	Pin 10	Sync GND

RS-232 (V24) Serial Interface (Interface numbers 1, 2 and 3)

Protocol:	Asynchronous
Baud Rate:	75 to 153600 Baud
Byte Format:	1 start bit, 8 data bits.
	0 or 1 parity bit (+ or -), programmable
	1 / 1.5 / 2 stop bits, programmable.
Transfer Control:	by means of DTR, DSR, CTS, RTS
Connection Socket:	3 x D subminiature (9 pole female), wired as DTE (Data Terminal Equipment).

Technical Data (cont.)

Pin Connections:	Channel 1, 2, 3:	Pin 3 TXD1 0	(output data)
		Pin 2 RXD1 I	(input data)
		Pin 7 RTS1 0	(request for output)
		Pin 8 CTS1 I	(ready for output)
		Pin 6 DSR1 I	(transfer unit ready)
		Pin 4 DTR1 0	(AT-10 ready)
		Pin 5 GND	

RS-422 Serial Interface

Protocol:	Asynchronous
Baud Rate:	75 to 153600 Baud
Byte Format:	1 start bit, 8 data bits.
	0 or 1 parity bit (+ or -), programmable
	1 / 1.5 / 2 stop bits, programmable.
Transfer Control:	None
Connection Socket:	1 x D-sub, 9 pole
Pin connections:	Pin 1 GND
	Pin 2 TXC +
	Pin 3 TXC -
	Pin 4 RXC +
	Pin 5 RXC -
	Pin 6 RXD +
	Pin 7 RXD -
	Pin 8 TXD +
	Pin 9 TXD -

Chapter 7
Glossary

Contents

Introduction

The following list provides a glossary of the important signals and acronyms used in the circuit diagrams for the SCHILLER instruments. They will not all apply to the SP-10.

Only abbreviations that are specific to SCHILLER equipment are included here. General electrical and electronic abbreviations are not included.

Acronyms

..OS	Offset signal (on the ECG amplifier)
A(1..n)	CPU Address Bus.
ALBEEP	Alarm beeper signal to the audio amplifier. The frequency of this signal is about 1000 Hz.
ANA1, ANA2	Analog input from the experimental inputs DC1 and DC2.
AS	Address strobe
BATT	Signal to CPU indicating battery operation
BATTLC	Analog signal to the processor giving the charge condition of the battery.
BATTV	Battery voltage - analog signal from the power supply used by the processor to assess battery or mains operation.
BLOW	Battery less than 11.3V. LCD flashes when this signal is active. When the battery voltage drops to below approximately 9.4V the unit is switched off. These values apply to equipment with 12 V battery. For other equipment the limits are different.
CHAD ..	ECG signal multiplexer control signals (on the ECG Amplifier)
CIF(0..16)	Communication interface. General control signals for the communication interface circuits.
CI(0..10)	RS interface control lines - input.
CO(0..10)	RS interface control lines - output.
CL1	19 kHz LCD latch pulse.
CL2	3.11 MHz LCD clock frequency.
CLK..	Clock Signal. The number following the CLK indicates the frequency. For example CLK 19 indicates a frequency of 19 MHz.
CS..	Chip select. The general format of the chip select signals is CS followed by some characters. The characters indicate the device to which the chip select signal appertains. For example CSRTC is the chip select signal for the real time clock and CSEPROM is the select signal fot the EPROM etc.
CTS	Clear to send. General signal used in data communication.
D (0..15)	Data Bus
DACWR	Digital / analog converter wire.
DIO..	Data input/output on the Data I/O connector
DMUX	Data multiplexer.
DRAM	Dynamic RAM
DRC(0..6)	Dynamic RAM control.
DS..	Data strobe.

Acronyms

DSP..	Digital signal processor (on program pack).
DTACK	Transfer data acknowledge. Bus signal to acknowledge transfer of data.
DTR	Outgoing serial data, turns modem on.
ECG1	ECG in - serial ECG data to the CPU sent over the optical interface.
ECGMUX	The multiplexed ECG signal from the ECG amplifier.
ECGO	ECG out - serial ECG amplifier control data from the CPU sent over the optical interface.
EF	Empty flag.
EJCT	Eject (paper tray).
EKGRES	Reset signal to the ECG Amplifier. This signal resets the ECG Amplifier to recenter the ECG image on the LCD.
FIFOR	First in first out read.
FLM	Control signal for frame synchronisation of the LCD.
FPIN	Input for floating point co-processor.
FWR	Flag read / write.
HREN	Output enable signal for thermal print head data (History enable).
HSYNC	Horizontal synchronisation (video / VGA output).
IPL0..2	Interrupt priority level (binary encoded).
IREG	Control signal from the current detector and limiter circuit on the power supply to regulate supply.
ISYS	Interrupt system (2 kHz).
KB..	Keyboard data in.
KBBEEP	Keyboard beep (to audio amplifier).
KBCLR	Keyboard clear.
KBCL1	Keyboard clock.
KBCL2	Keyboard clock.
KBIN..	Keyboard data in - serial data from the keyboard to the CPU.
KBS..	Keyboard Strobe.
KONV	Convert - this signal initiates the conversion of the incoming signal from the ECG Amplifier..
LA	Left Arm.
LCA	Liquid crystal address - enable.
LCDAS	LCD Address Strobe.

Acronyms

LCDKONT	LCD contrast - sets the -18 V voltage level (from which the LCD backlight power is generated) and thus the contrast of the screen.
LCDW	LCD Write.
LD1,2,3,4	Lower LCD data.
LDS	Lower data strobe.
LED (0..3)	Operate signals to the LED indicators on the keyboard.
LEDB	Battery LED.
LEDMAINS	Signal indicating mains connected - to operate LED indicator on the keyboard.
LOE	Lower output enable - control signal for static Ram.
LP	Line synchronisation.
LSRAM	Lower output enable - control signal for static RAM.
LWE	Lower Write Enable - control signal for Static Ram.
M	LCD control signal derived from FLM.
MCLK	Motor Clock - speed control for the printer motor.
MOD	Control signal from the battery charging circuit.
MOFF	Motor off.
MON	Motor On - Printer motor enable signal.
NWTZ	Mains supply.
NMI	Non-maskable interrupt - interrupt for U47 (Schiller gate array) activated by the reset button.
OFF	Off signal from the OFF key to switch off the power supply.
PDS	Control signal derived from FLM (unity waveform 1/2 FLM frequency).
PM	Paper mark signal.
PMARK	Paper mark detection signal.
PMPON	Pacemaker detection pulse.
PMNEG	Pacemaker negative - indicates the trailing edge of a pacemaker pulse.
PMPOS	Pacemaker positive - indicates the leading edge of a pacemaker pulse.
PWM	Pulse Width Modulation
QTRRG	QRS trigger - output signal.
RA	Right Arm.
RAS	Row address strobe.
RES	Reset.

Acronyms

RESLCD/	Resets / darkens the LCD.
RES/P	Error reset signal to inactivate the LCD.
RTS	Ready to send - ougoing serial data, handshake with CTS.
RXD	Receive data - incoming serial data.
R / W	Read / Write
SC(0..8)	System control bus - CPU control signals.
SCINV	Screen inversion.
SI	Serial in.
SO	Serial output from the CPU to the ECG amplifier via opto isolators.
SP..	Spirometry control and data signals.
SRAM	Static RAM memory.
STRB1/2	Timing signals for printer control.
SYSEN	System enable - active when the program pack is inserted. The CPU will not work if this signal is not active.
TGATE	Gate pulse for programmable timer. This signal sets the TPDUR signal.
TM	Thermal printer temperature - dc voltage from the print head, pulse width modulation of signal TPTH.
TPC	Thermal printer clock. This is not a continuous clock signal but is active when loading a line of printer data (into shift registers).
TPCLK	Thermal printer clock.
TPD	Thermal printer data - serial data for the printer.
TPDUR	Thermal printer duration - duration of the strobe pulse dependant on the ambient temperature of the print head and the resistance of the print head.
TPCSEL	Thermal printer controller select - control of thermal printer FIFO (input memory buffer).
TPL	Thermal printer latch - print strobe control and data latch signal.
TPRES	Thermal printer reset - FIFO reset for thermal printer controller.
TPS 0 & 1	Thermal Printer Strobe - master timing strobe enable signal.
TPTH	Thermal Printer temperature - dc voltage from the print head to ADC, approximately 3.7V at room temperature.
TS	Temperature sense (from battery).
TXD	Outgoing serial data.

Acronyms

µPOFF	Off control signal. Logic 1 keeps the unit switched on, Logic 0 switches the unit off . Note that the unit is initially switched on directly from the ON key on the keyboard.
U1,2,3,4	Upper LCD data.
+UB	Battery voltage.
UCAS	Upper column address strobe (for dynamic RAM).
UD1, UD2	Upper data strobe - used for generating UOE and UWE.
UDS	Upper Data Strobe - used on the SCHILLER gate array.
UOE, USRAM	Upper output enable - for static RAM.
+UP	Voltage rectified from the mains input and regulated to approximately + 15 V.
UWE	Upper Write Enable - for static RAM.
+U	Unregulated dc supply from mains (approximately 30 V).
+UBU	Back-up voltage for the real time clock and static RAM.
+UD	Unswitched regulated dc voltage used as power source for the switched supply +US. The voltage is 13.5V when mains is connected, or battery voltage when mains is not connected. When mains is connected, this supply charges the battery.
-ULCD	Contrast voltage to LCD.
+US	Switched dc voltage of 13.5V when mains is connected or battery voltage when working from the battery. Input voltage for all PSUs on the power supply board.
VCC	+5 V.
VMA	Valid memory address.
VPA	Valid peripheral address.
VSYNC	Vertical synchronisation - (video / VGA output).
WP0 and WP1	ECG In - the serial multiplexed ECG serial data to the CPU sent over the optical interface, from the ECG Amplifier.
XD0..XD3	Pixel information.
XSCL	Shift clock for XDn.
YD	Frame synchronisation.
YDIS/	LCD off.
ZEROSET	Baseline reset (on the ECG amplifier) from the processor.

Service Handbook Document History SP-10

Service Handbook Issue 2 July 1998 Art. No. 2.540 006 Delivery date: 13.07.98

							Receipt Acknowledged						
Unit	Detail	Article Number	Drawing date	Description	HW	Delivery date	DE	AU	IT	FR	US	CAN	CHD
SP-10	MK8-11SP	2241Ba	18.09.92	Program Pack SP-10									
		2241Ca	07.12.92			13.07.98							
SP-10	MK8-1SP	2231Ca	09.12.92	Processor Board SP-10									
		2231Da	06.01.93			13.07.98							
SP-10	MK8-4	2236Aa	03.07.92	Connector Board									
		2236Ba	24.07.92										
		2236Ca	03.12.92										
		2236Cb	24.06.96			13.07.98							
SP-10	MK8-5	2237Da	22.05.97	Printer Interface		13.07.98							
SP-10	MK8-6	2238Ba	25.11.92	Power Supply									
		2238Bg	30.09.93										
		2238Ca	10.12.93										
		2238Da	21.02.94										
		2238Db	10.08.95										
		2238Dc	24.08.95										
		2238Dd	08.11.95										
		2238EA		kein Schema vorhanden									
		2238EB	03.02.97										
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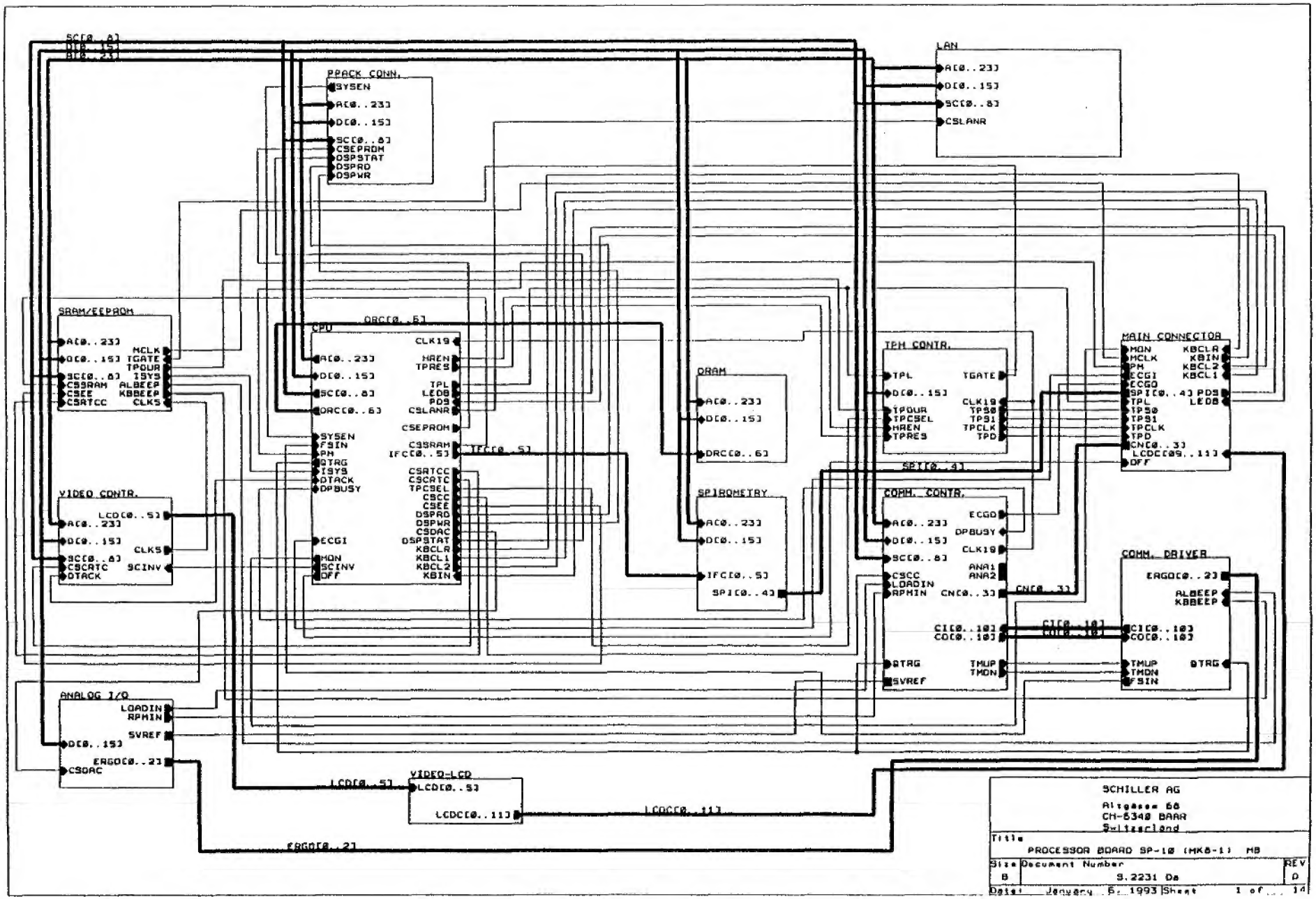
		2238ED		kein Schema vorhanden									
		2238EE	19.01.98										
		2238EF	19.01.98			13.07.98							
SP-10	MK8-7	2239Aa	08.07.92	Connector RS232/422									
		2239Ba	23.08.92										
		2239Ca	17.11.92			13.07.98							
SP-10	SP8-3D	2291Da	01.03.94	Keyboard English									
SP-10	SP8-3D	2292Da	01.03.94	Keyboard French									

SP-10	SP8-3D	2290Aa 2290Ba 2290Da	27.08.92 11.11.92 01.03.94	Keyboard German KEIN Ca		13.07.98							
SP-10	SP8-3D	2293Da	01.03.94	Keyboard Italian									



SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland

Title
PROCESSOR BOARD SP-10 (MK8-1) MB

Size	Document Number	REV
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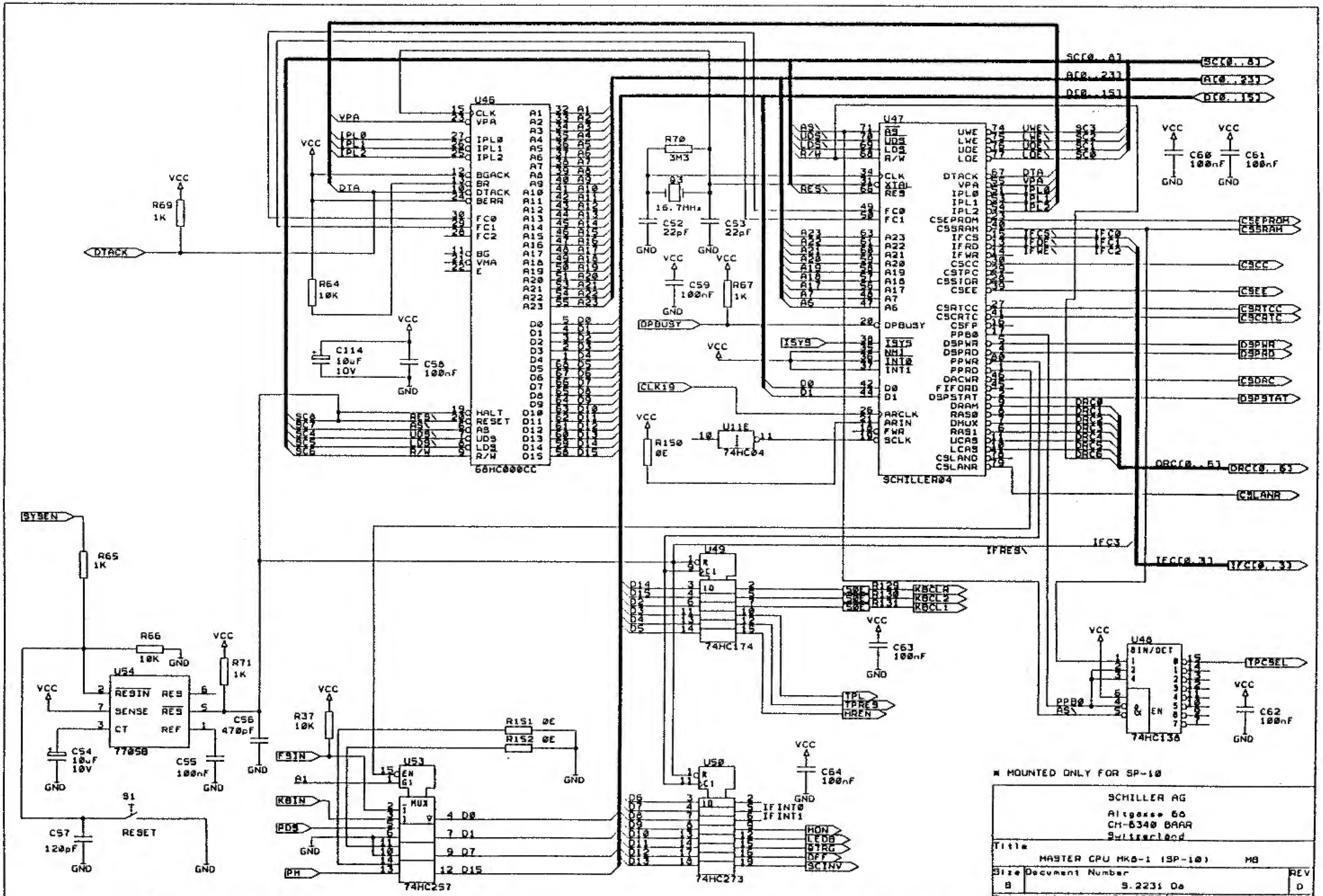
Date: January 6, 1993 | Sheet 1 of 14



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U47
SCHILLER04
U49
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U50
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74HC257
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U11E
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IFINT1
HON
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KBIN
PDS
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RESET
* MOUNTED ONLY FOR SP-10
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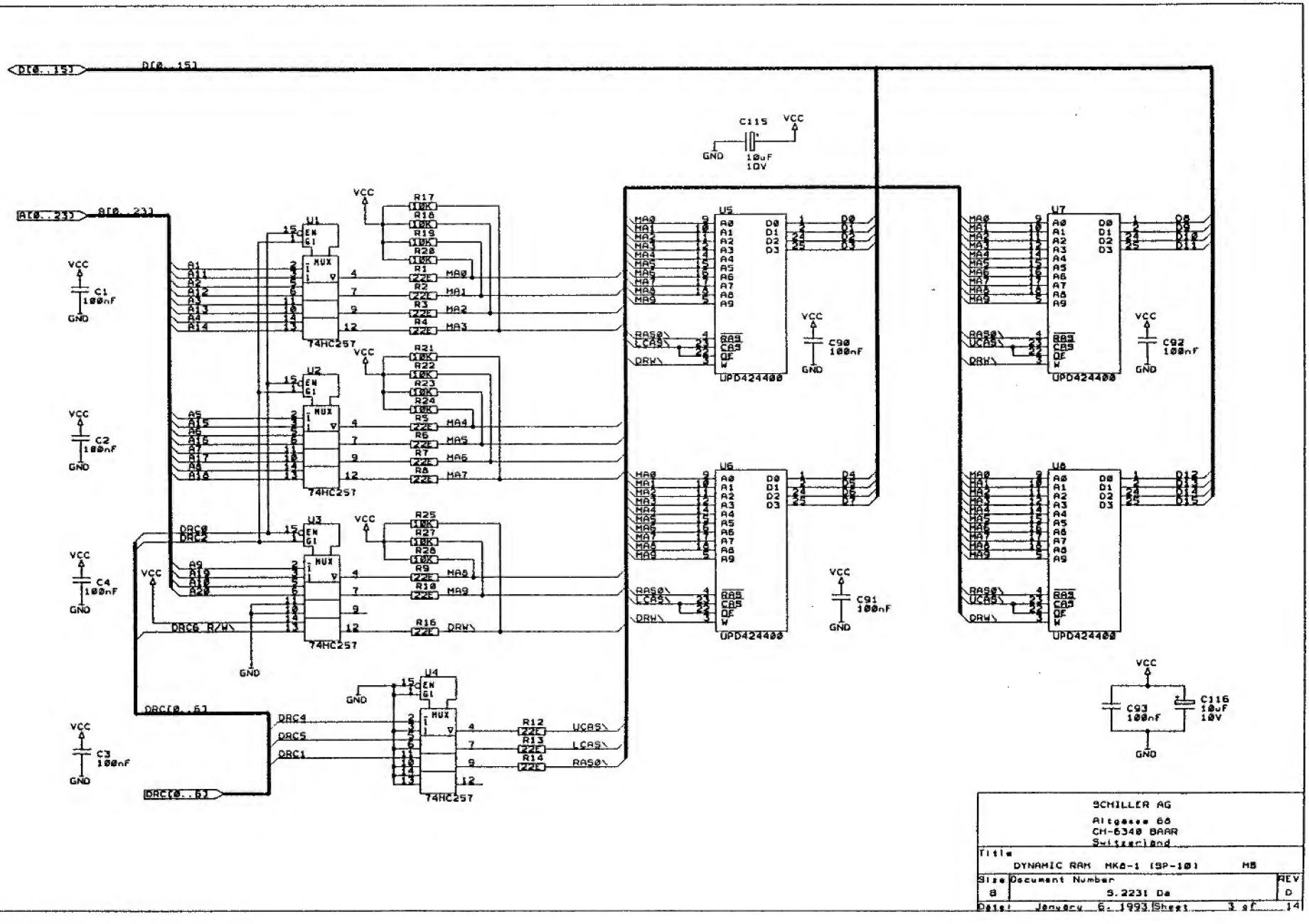
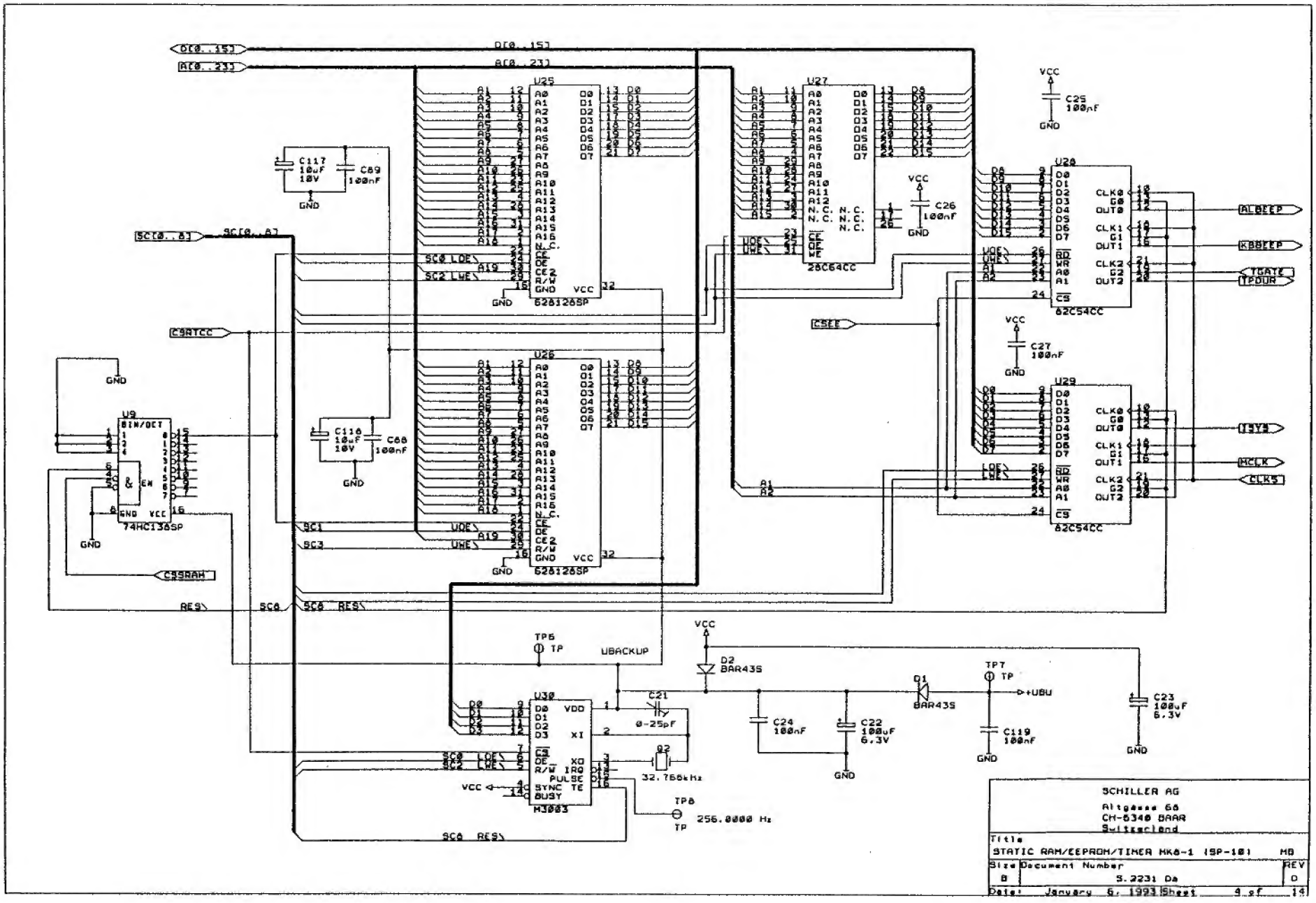
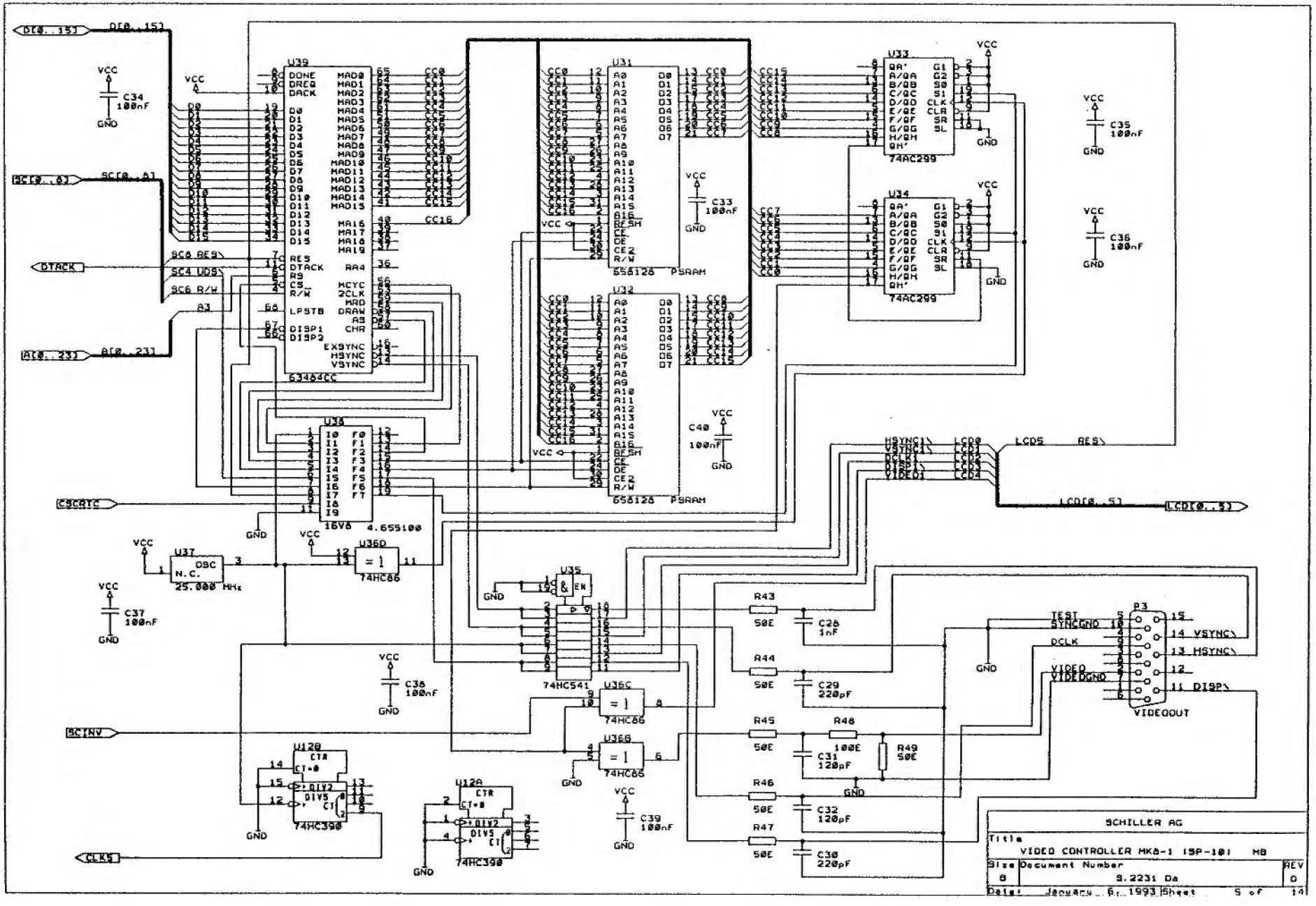
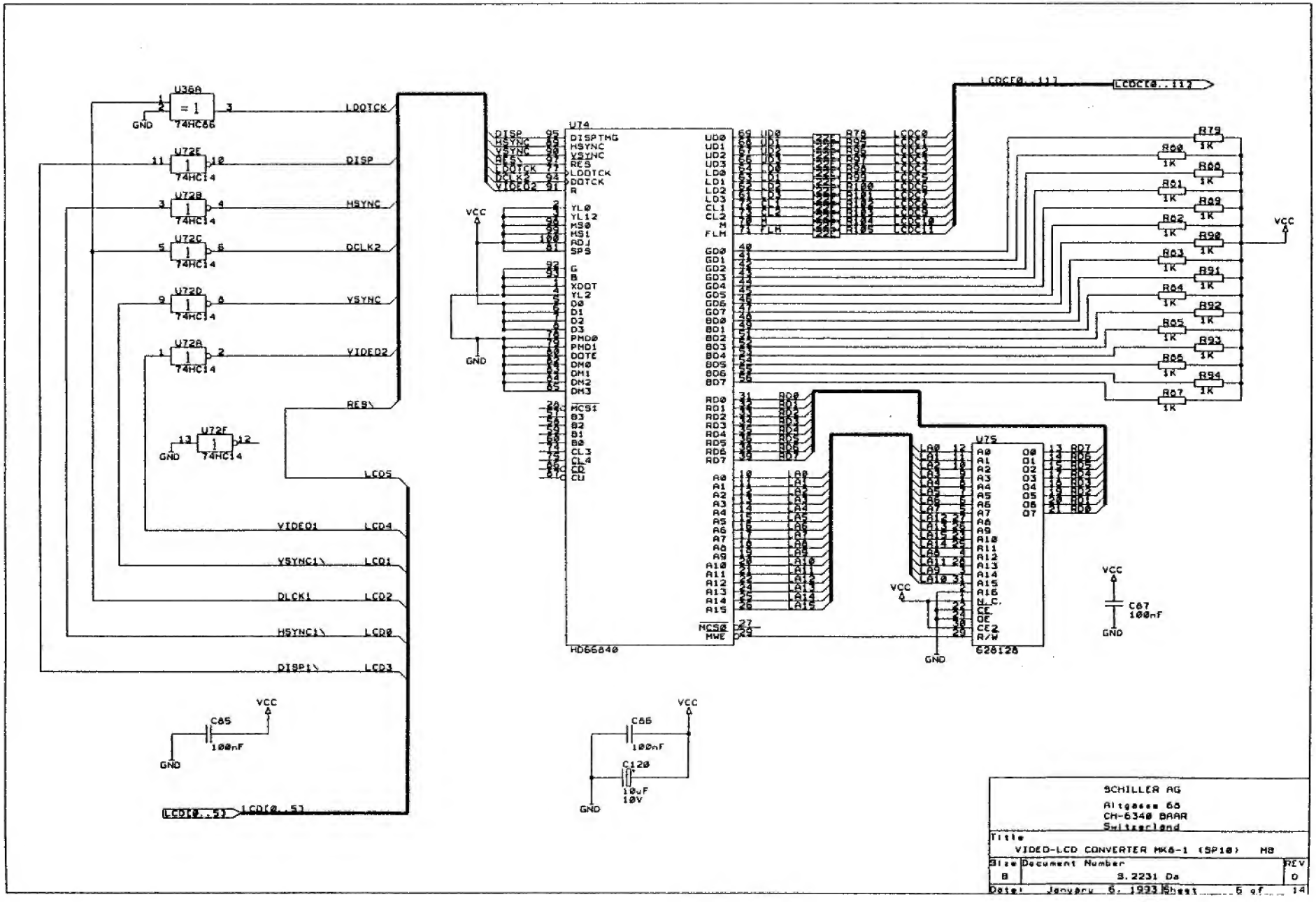
Size B
Document Number 5.2231 Da
REV D
Date: January 5, 1993 Sheet 2 of 14

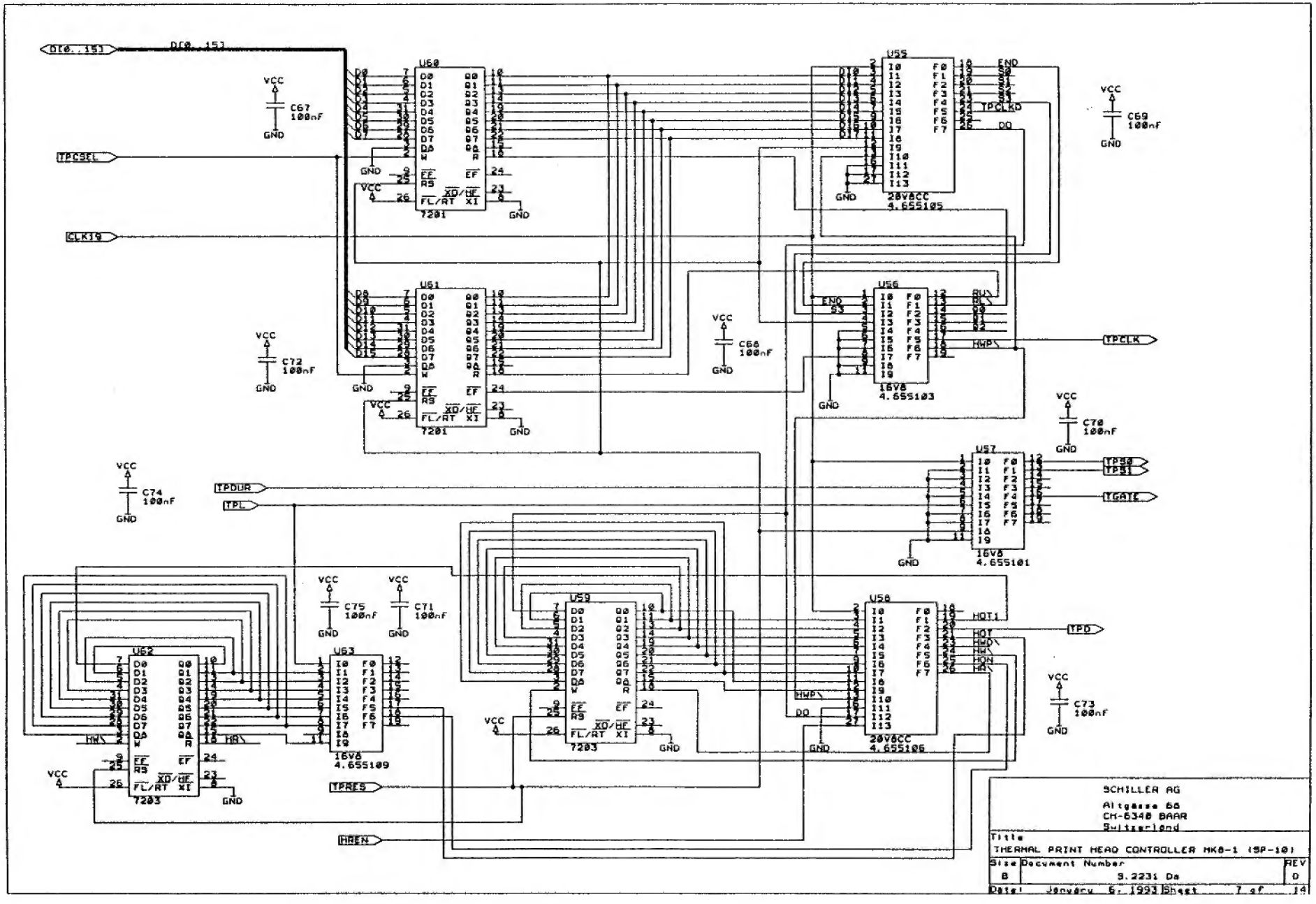


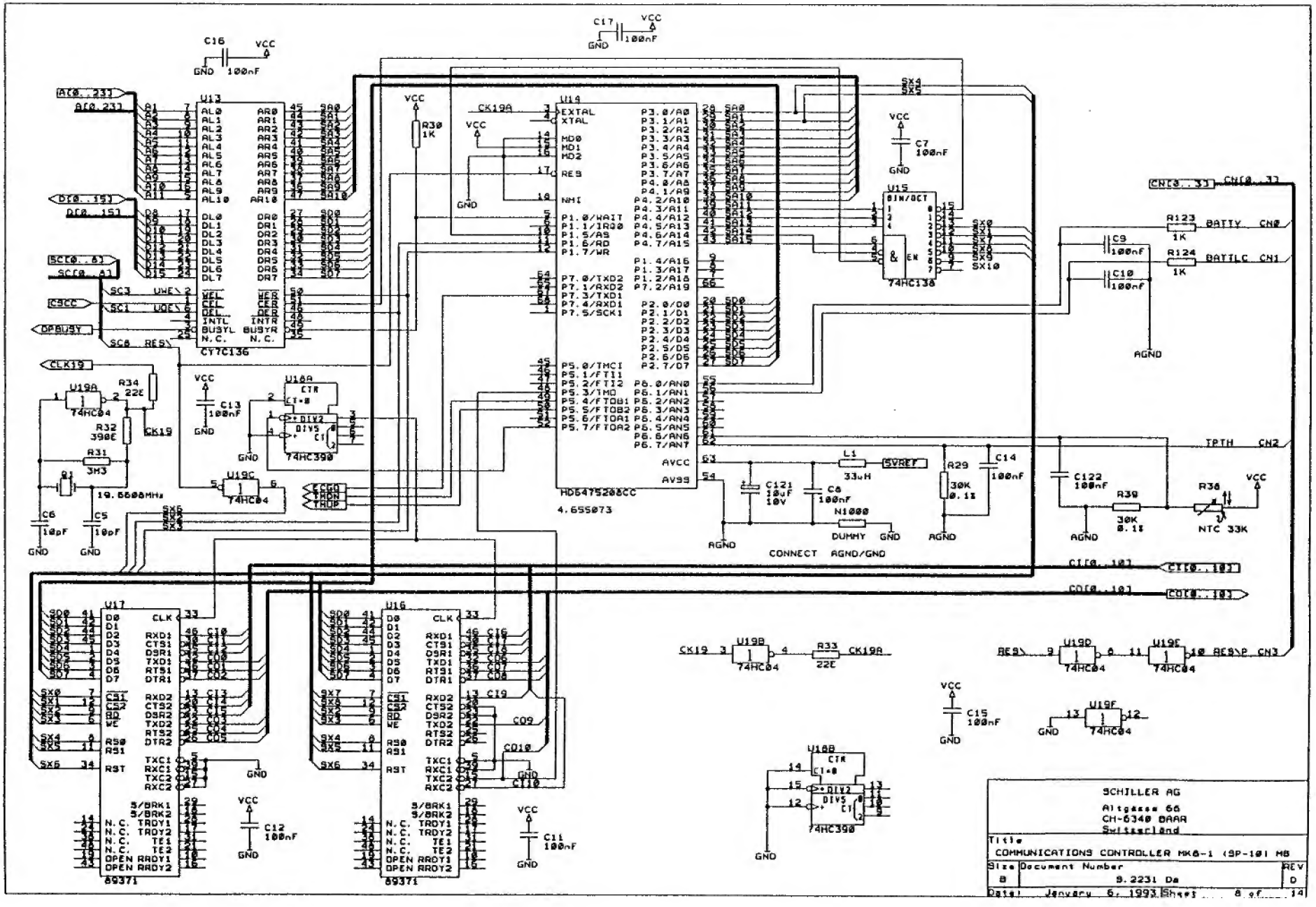
SCHILLER AG	
Altgasse 68 CH-6340 BAAR Switzerland	
Title: DYNAMIC RAM MKA-1 (SP-10) MB	
Size: B	Document Number: 5.2231 Da — REV: D
Date: January 6, 1993	Sheet 3 of 14

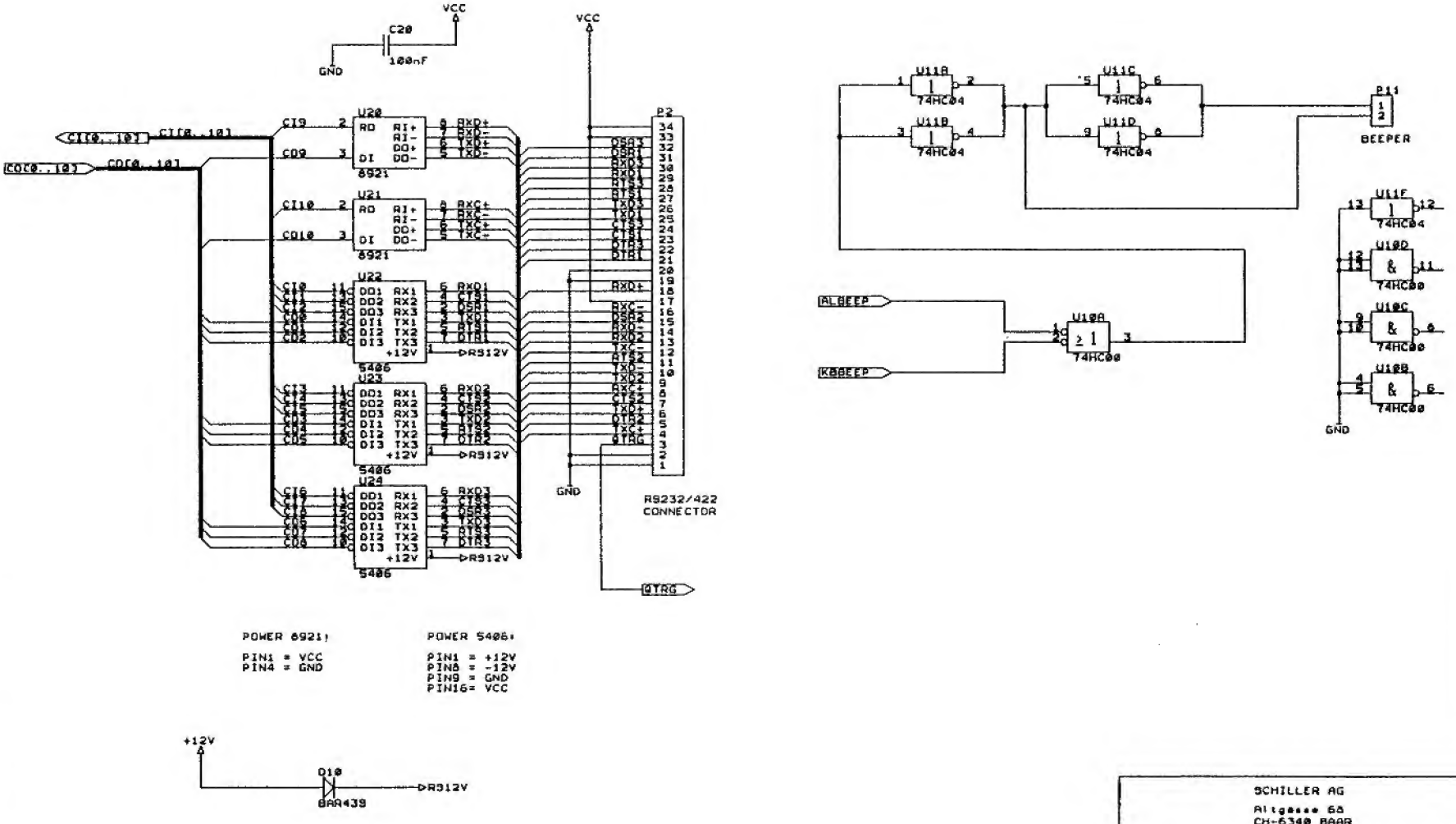

D[0..15]
A[0..23]
SC[0..8]
SC[0..8]
U25
U26
U27
U28
U29
U9
U30
28C64CC
82C54CC
74HC138SP
M3003
628128SP
VCC
GND
C117 10uF 10V
C89 100nF
C116 10uF 10V
C88 100nF
C25 100nF
C26 100nF
C27 100nF
C24 100nF
C22 100uF 6.3V
C23 100uF 6.3V
C119 100nF
C21 0-25pF
Q2 32.768kHz
D2 BAR43S
D1 BAR43S
TP5 TP
TP6 TP
TP7 TP
TP8 TP
256.0000 Hz
+UBU
UBACKUP
ALBEEP
KBBEEP
TGATE
TPOUR
ISYS
MCLK
CLKS
CSEE
CSRTCC
CSSRAM
SC0 LOE\
SC1 UOE\
SC2 LWE\
SC3 UWE\
SC0 RES\
RES\
A19
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
STATIC RAM/EEPROM/TIMER MK8-1 (SP-181)
MB
Size B
Document Number S.2231 Da
REV D
Date: January 6, 1993 Sheet 4 of 14


U39
63484CC
U31
U32
U33
U34
74AC299
74AC299
U36
16V8
4.655100
U37
OSC
N.C.
25.000 MHz
U36D
74HC86
U35
74HC541
U36C
74HC86
U36B
74HC86
U12B
74HC390
U12A
74HC390
R43
R44
R45
R46
R47
R48
R49
C26
1nF
C29
220pF
C31
120pF
C32
120pF
C30
220pF
C34
C35
C36
C37
C38
C39
C40
100nF
P3
VIDEOOUT
SCHILLER AG
VIDEO CONTROLLER MK8-1 ISP-101 M8
S.2231 Da
January 6, 1993
Sheet 5 of 14

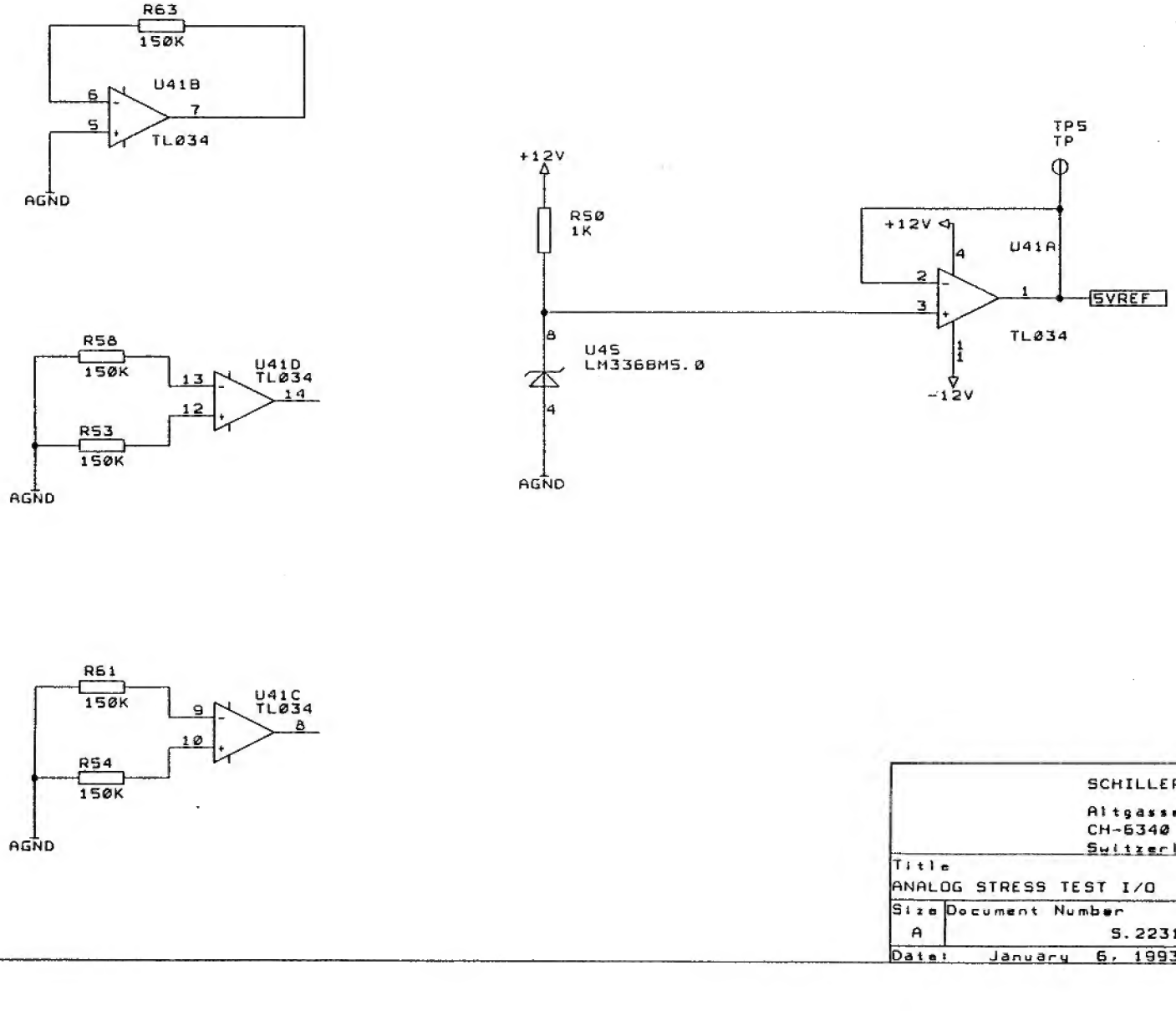

U36A
74HC86
LDOTCK
U72F
74HC14
DISP
U72B
HSYNC
U72C
DCLK2
U72D
VSYNC
U72A
VIDEO2
RES\
U72F
LCD5
VIDEO1
LCD4
VSYNC1\
LCD1
DLCK1
LCD2
HSYNC1\
LCD0
DISP1\
LCD3
LCD[0..5]
LCD[0..5]
GND
VCC
C85
100nF
U74
HD66840
DISPTMG
HSYNC
VSYNC
RES
LDOTCK
DOTCK
R
YL0
YL12
MS0
MS1
ADJ
SPS
G
B
XDOT
YL2
D0
D1
D2
D3
PMD0
PMD1
DOTE
DM0
DM1
DM2
DM3
MCS1
B3
B2
B1
B0
CL3
CL4
CD
CU
UD0
UD1
UD2
UD3
LD0
LD1
LD2
LD3
CL1
CL2
M
FLM
GD0
GD1
GD2
GD3
GD4
GD5
GD6
GD7
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
RD0
RD1
RD2
RD3
RD4
RD5
RD6
RD7
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
MCS0
MWE
LCDC[0..11]
LCDC[0..11]
R78
R00
R01
R09
R02
R90
R03
R91
R04
R92
R05
R93
R06
R94
R07
1K
U75
628128
N.C.
CE
OE
CE2
R/W
C87
100nF
C86
100nF
C120
10uF
10V
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
VIDEO-LCD CONVERTER MK6-1 (SP10) M8
Size
B
Document Number
S.2231 Da
REV
0
Date: January 6, 1993
Sheet 6 of 14


DI0..15\
D0..15\
U60
U61
U62
U63
U55
U56
U57
U58
U59
7201
7203
16V8
20V8CC
4.655105
4.655103
4.655101
4.655106
4.655109
C67 100nF
C72 100nF
C74 100nF
C75 100nF
C71 100nF
C68 100nF
C70 100nF
C69 100nF
C73 100nF
VCC
GND
TPCSEL
CLK19
TPDUR
TPL
TPRES
HREN
TPCLKD
TPCLK
TPSO
TPS1
TGATE
TPD
HOT1
HOT
HWD
HW\
HON
HA\
HWP
DQ
END
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
THERMAL PRINT HEAD CONTROLLER MK8-1 (SP-10)
Size B
Document Number 9.2231 Da
REV D
Date: January 6, 1993 Sheet 7 of 14


U13
CY7C136
U14
HD6475208CC
4.655073
U15
74HC138
U16
89371
U17
89371
U18A
74HC390
U18B
74HC390
U19A
U19B
U19C
U19D
U19E
U19F
74HC04
U16A
74HC390
VCC
GND
AGND
CONNECT AGND/GND
DUMMY
SCHILLER AG
Altgasse 66
CH-6340 BAAR
Switzerland
COMMUNICATIONS CONTROLLER MK6-1 (SP-101 MB
Size B
Document Number 9.2231.Da
REV D
Date: January 6, 1993
Sheet 8 of 14



SCHILLER AG Altgasse 68 CH-6340 BAAR Switzerland		
Title: COMMUNICATIONS DRIVER MX6-1 (SP-10)		
Size: B	Document Number: 9.2231.Da	REV: D
Date: January 6, 1993	Sheet 9 of 14	

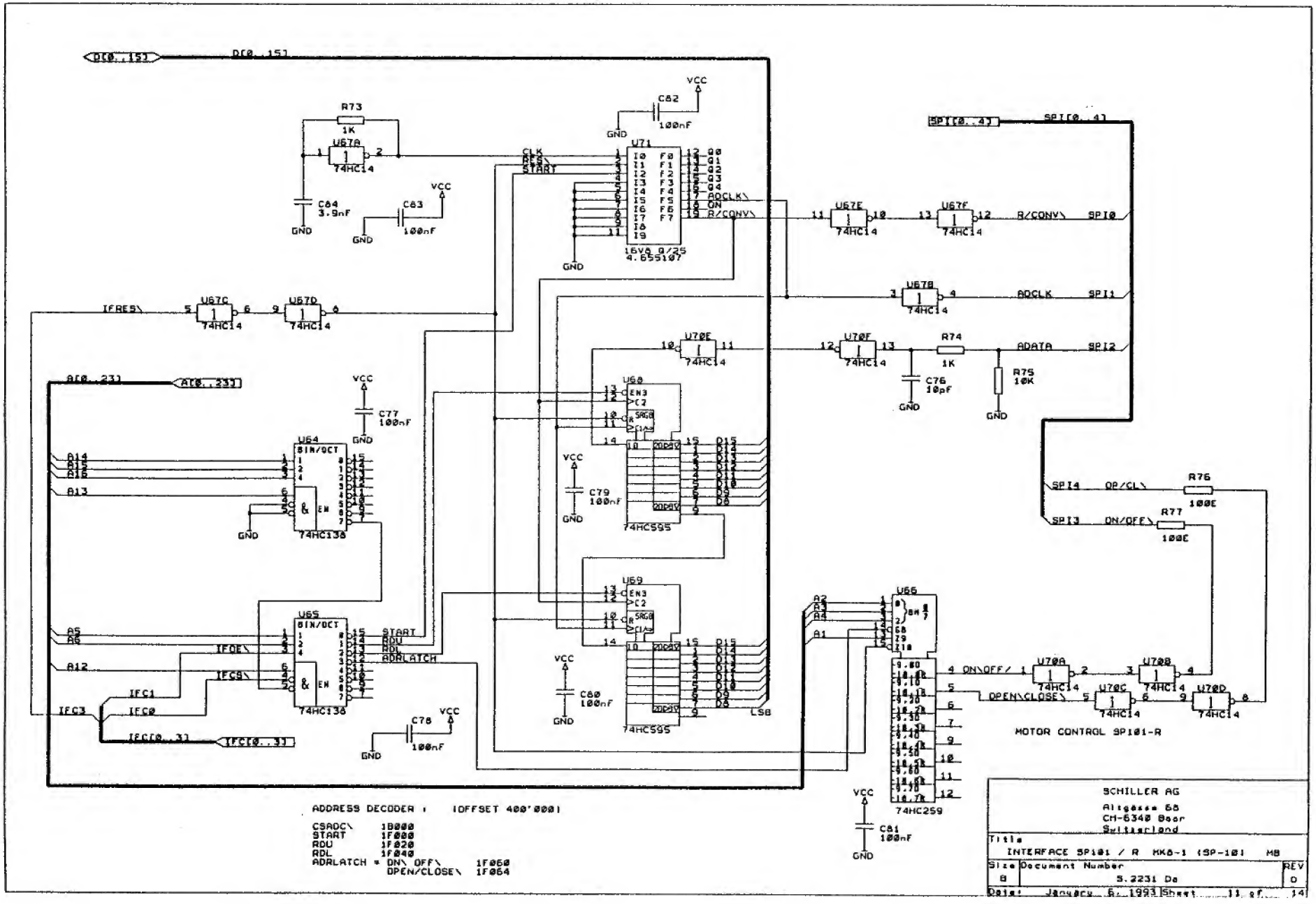


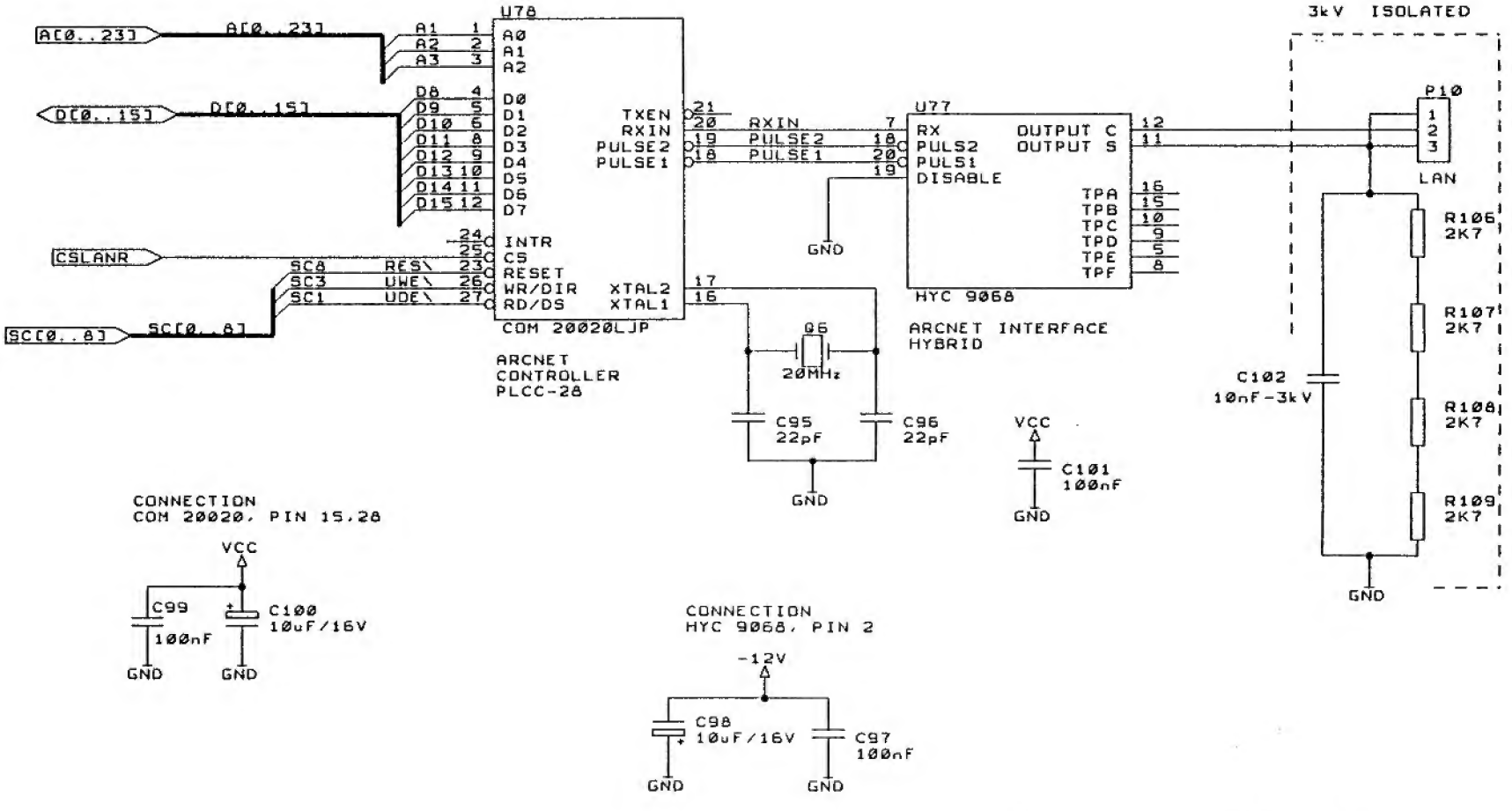
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland

Title
ANALOG STRESS TEST I/O MK8-1 (SP-10) MB

Size	Document Number	REV
A	S.2231 Da	D

Date: January 6, 1993 Sheet 10 of 14


D[0..15]
R73
1K
U67A
74HC14
C84
3.9nF
C83
100nF
C82
100nF
U71
CLK
OES\
START
ADCLK\
ON
R/CONV\
16V8 0/25
4.655107
SPI[0..4]
U67E
U67F
R/CONV\
SPI0
U67B
ADCLK
SPI1
IFRES\
U67C
U67D
U70E
U70F
R74
1K
ADATA
SPI2
C76
10pF
R75
10K
A[0..23]
C77
100nF
U64
BIN/OCT
74HC138
U60
74HC595
C79
100nF
SPI4
OP/CL\
R76
100E
SPI3
ON/OFF\
R77
100E
U69
74HC595
C80
100nF
U65
BIN/OCT
74HC138
IFOE\
IFCS\
IFC1
IFC0
IFC3
IFC[0..3]
START
RDU
RDL
ADRLATCH
C78
100nF
LSB
U66
74HC259
C81
100nF
ON\OFF/
OPEN\CLOSE\
U70A
U70B
U70C
U70D
MOTOR CONTROL SPI01-R
ADDRESS DECODER : (OFFSET 400'000)
CSADC\ 1B000
START 1F000
RDU 1F020
RDL 1F040
ADRLATCH = ON\ OFF\ 1F060
OPEN/CLOSE\ 1F064
SCHILLER AG
Altgasse 68
CH-6340 Baar
Switzerland
Title
INTERFACE SP101 / R MK6-1 (SP-101 MB
Size B
Document Number S.2231 Da
REV D
Date: January 6, 1993 Sheet 11 of 14

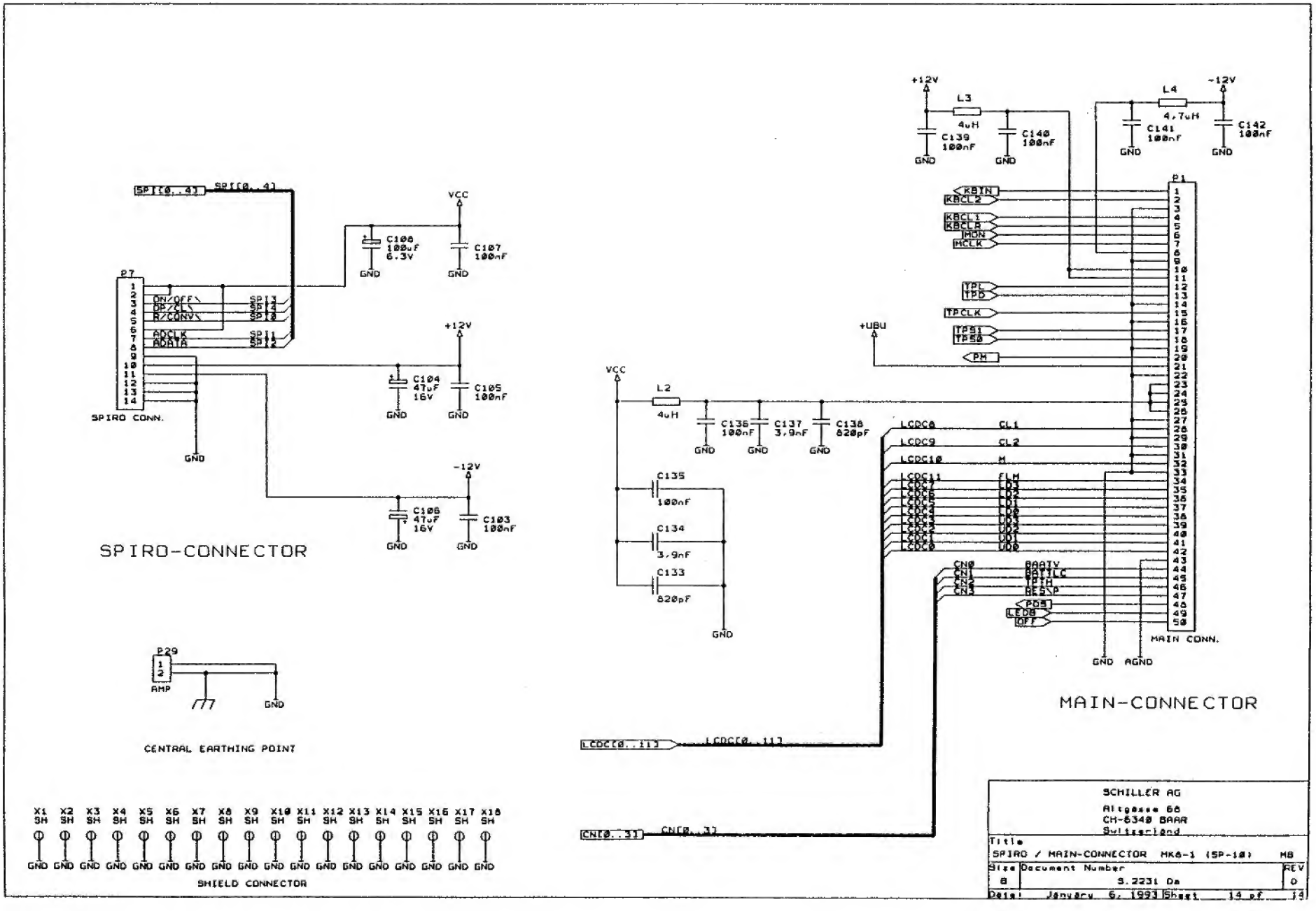


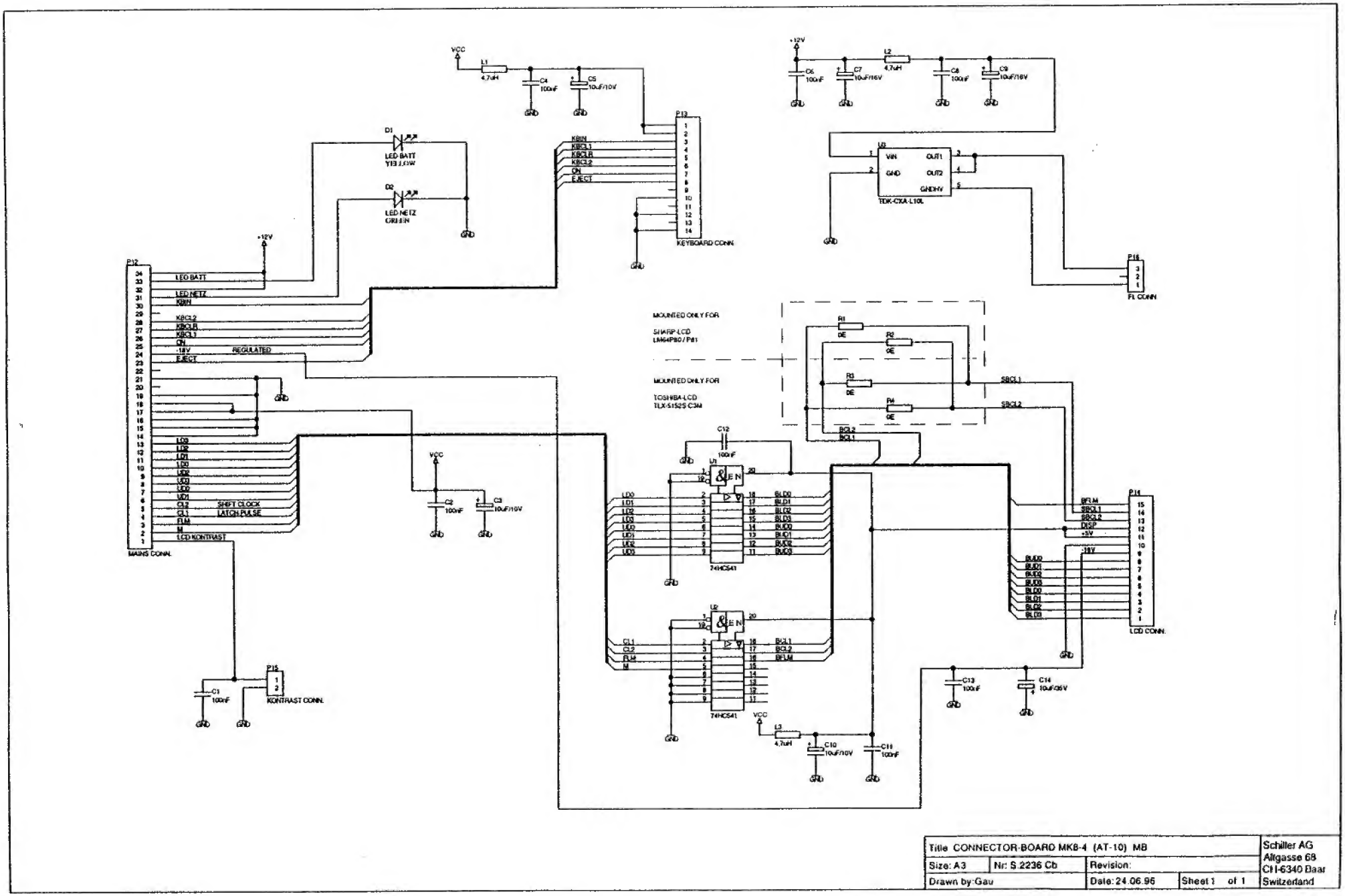
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland

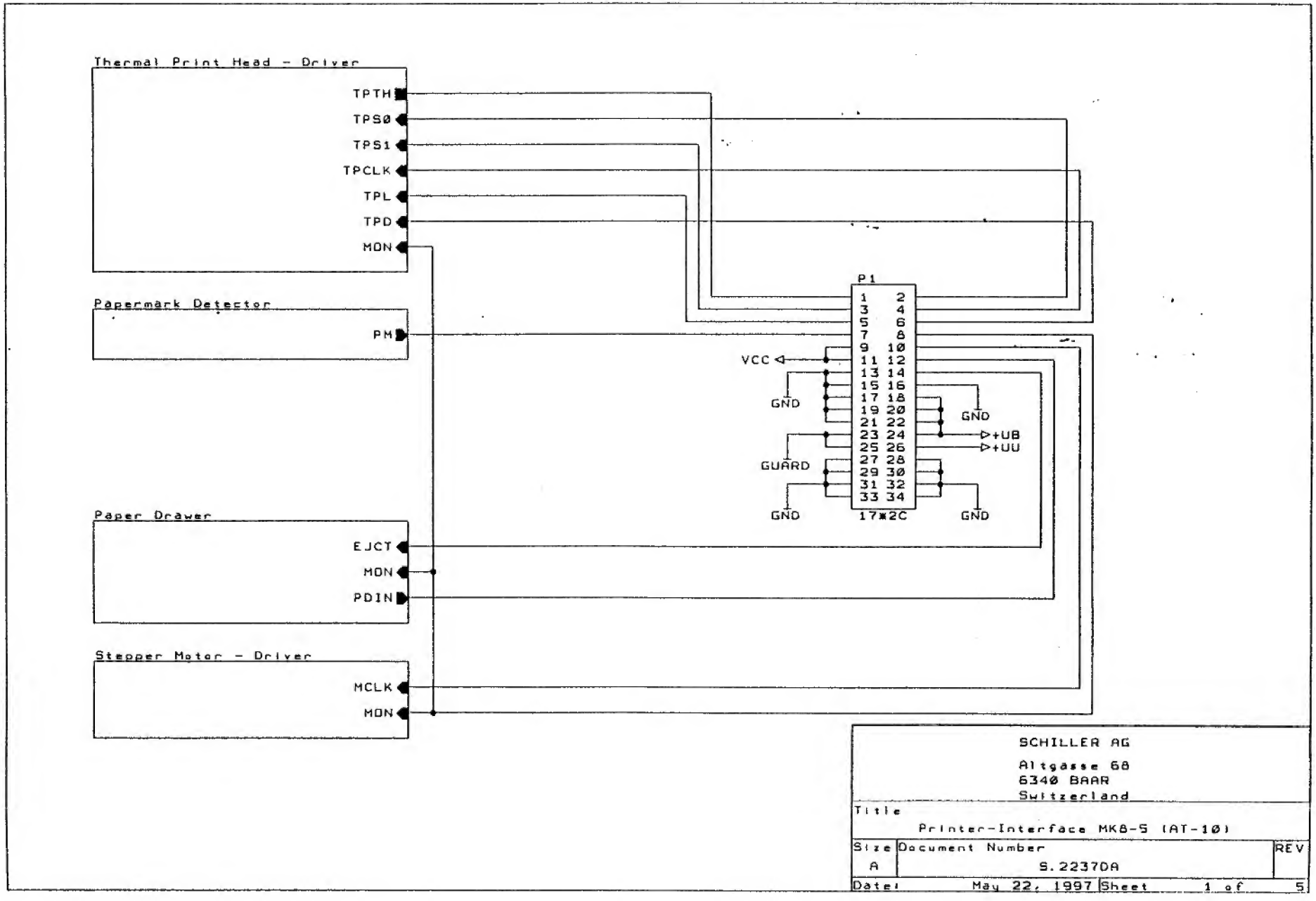
Title
LAN CONTROLLER MK8-1 (SP-10) M8

Size	Document Number	REV
A	S.2231 Da	D

Date: January 6, 1993 Sheet 12 of 14


SPIRO-CONNECTOR
MAIN-CONNECTOR
CENTRAL EARTHING POINT
SHIELD CONNECTOR
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
SPIRO / MAIN-CONNECTOR MK8-1 (SP-18)
MB
Size
B
Document Number
3.2231.Da
REV
0
Date: January 6, 1993 Sheet 14 of 14

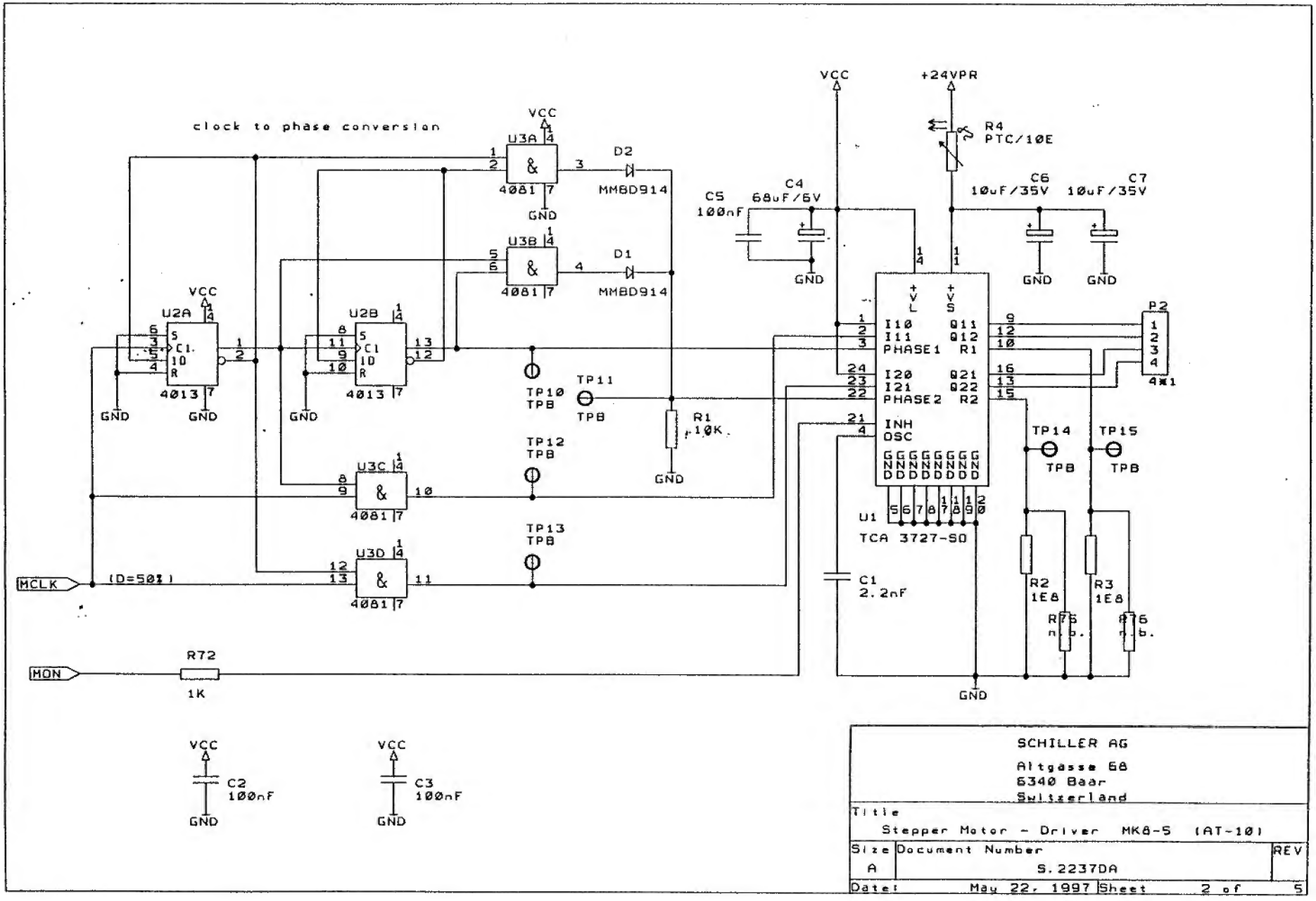

MAINS CONN.
KEYBOARD CONN.
FL CONN.
KONTRAST CONN.
LCD CONN.
LED BATT
LED NETZ
KBIN
KBCL2
KBCLR
KBCL1
ON
-18V
REGULATED
EJECT
SHIFT CLOCK
LATCH PULSE
FLM
M
LCD KONTRAST
LD3
LD2
LD1
LD0
UD3
UD2
UD1
UD0
CL2
CL1
KBCL2
KBCLR
KBCL1
SBCL1
SBCL2
BCL2
BCL1
BFLM
DISP
+5V
-18V
MOUNTED ONLY FOR
SHARP LCD
LM64P80 / P81
MOUNTED ONLY FOR
TOSHIBA LCD
TLX-5152S C3M
74HC541
TDK-CXA-L10L
LED BATT
YELLOW
LED NETZ
GREEN
Title CONNECTOR-BOARD MK8-4 (AT-10) MB
Size: A3
Nr: S.2236 Cb
Revision:
Drawn by: Gau
Date: 24.06.96
Sheet 1 of 1
Schiller AG
Altgasse 68
CH-6340 Baar
Switzerland

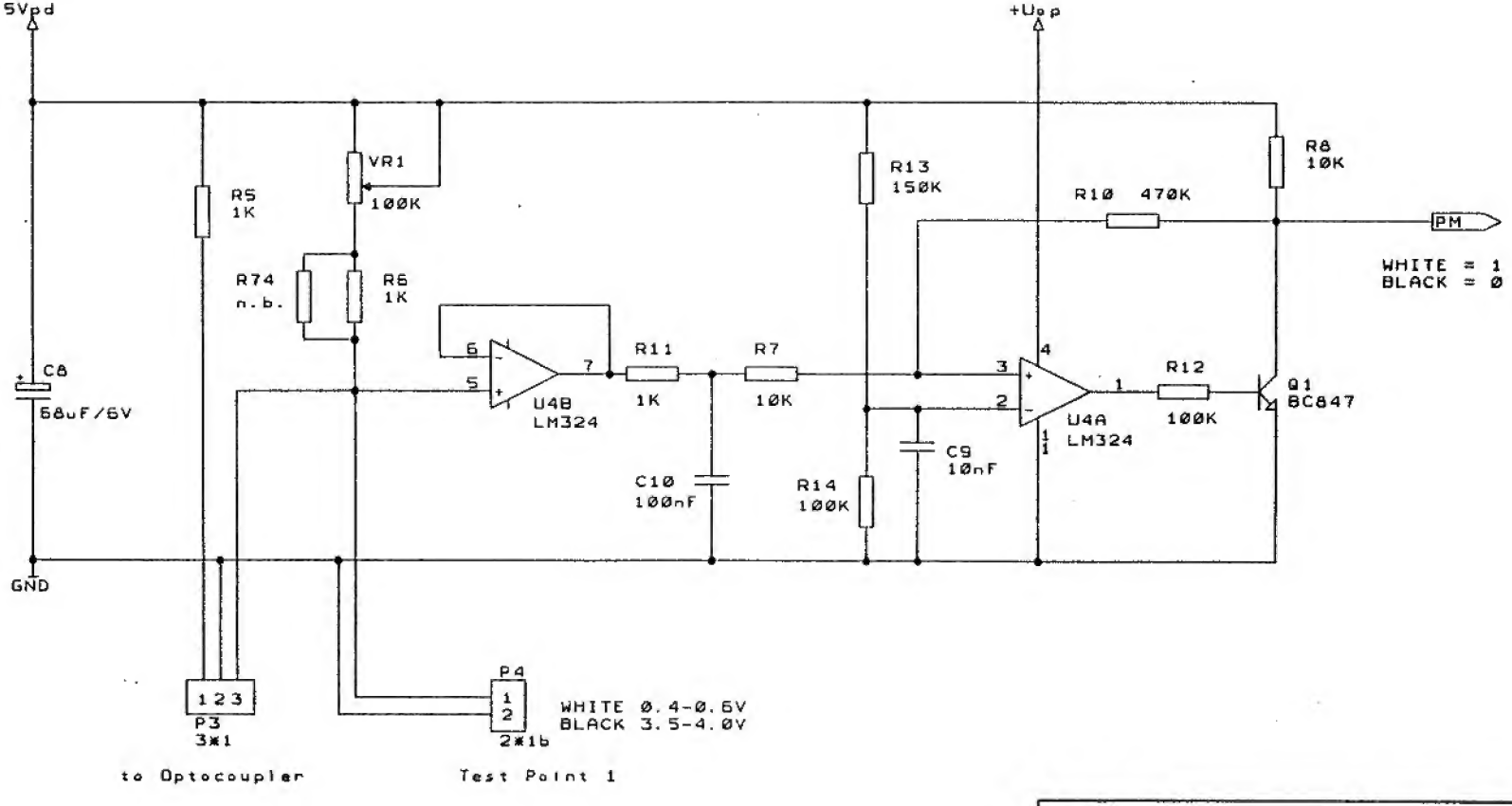


SCHILLER AG

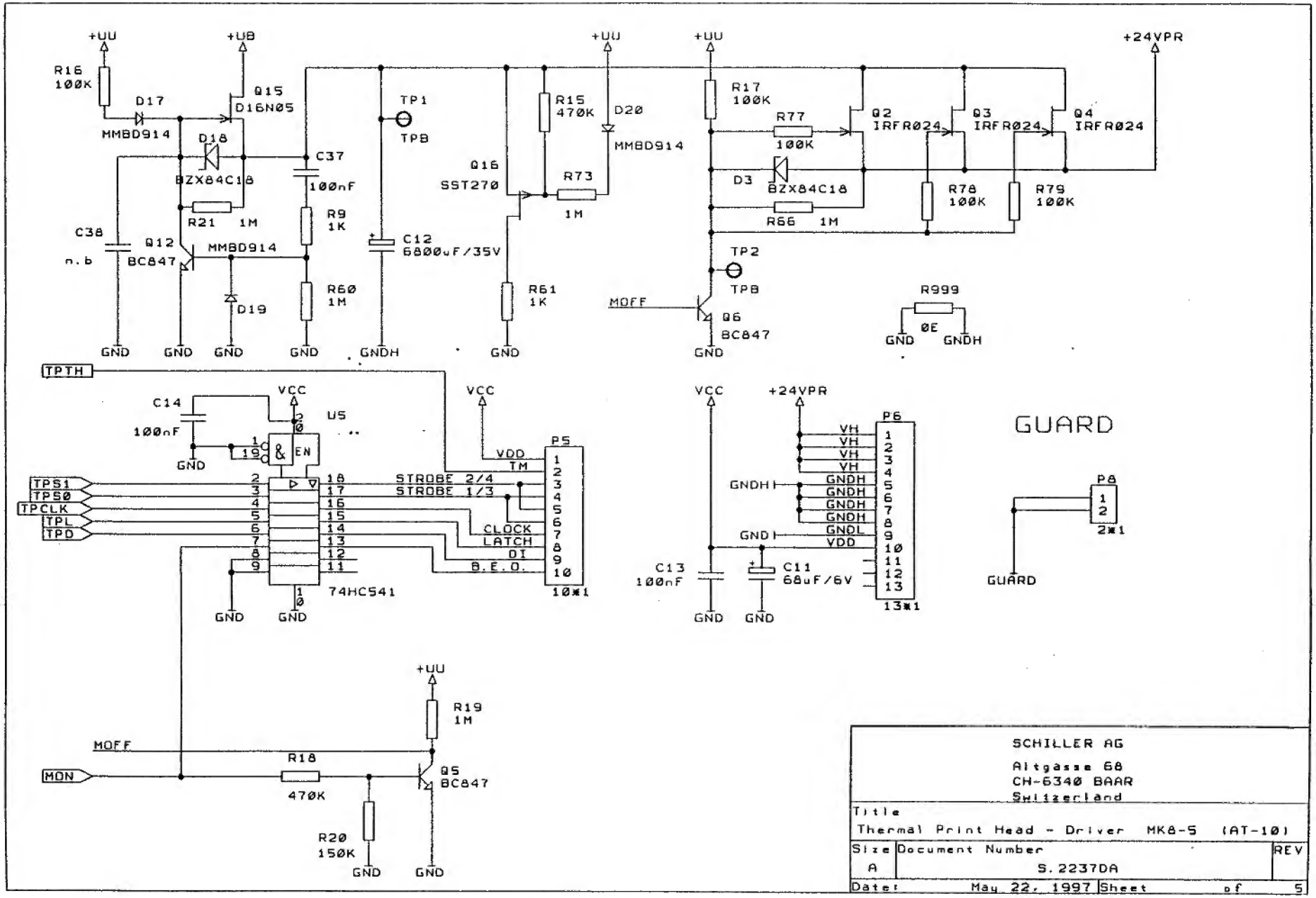
Altgasse 68
6340 BAAR
Switzerland

Title: Printer-Interface MK8-S (AT-10)		
Size: A	Document Number: S.22370A	REV
Date: May 22, 1997	Sheet 1 of 5	

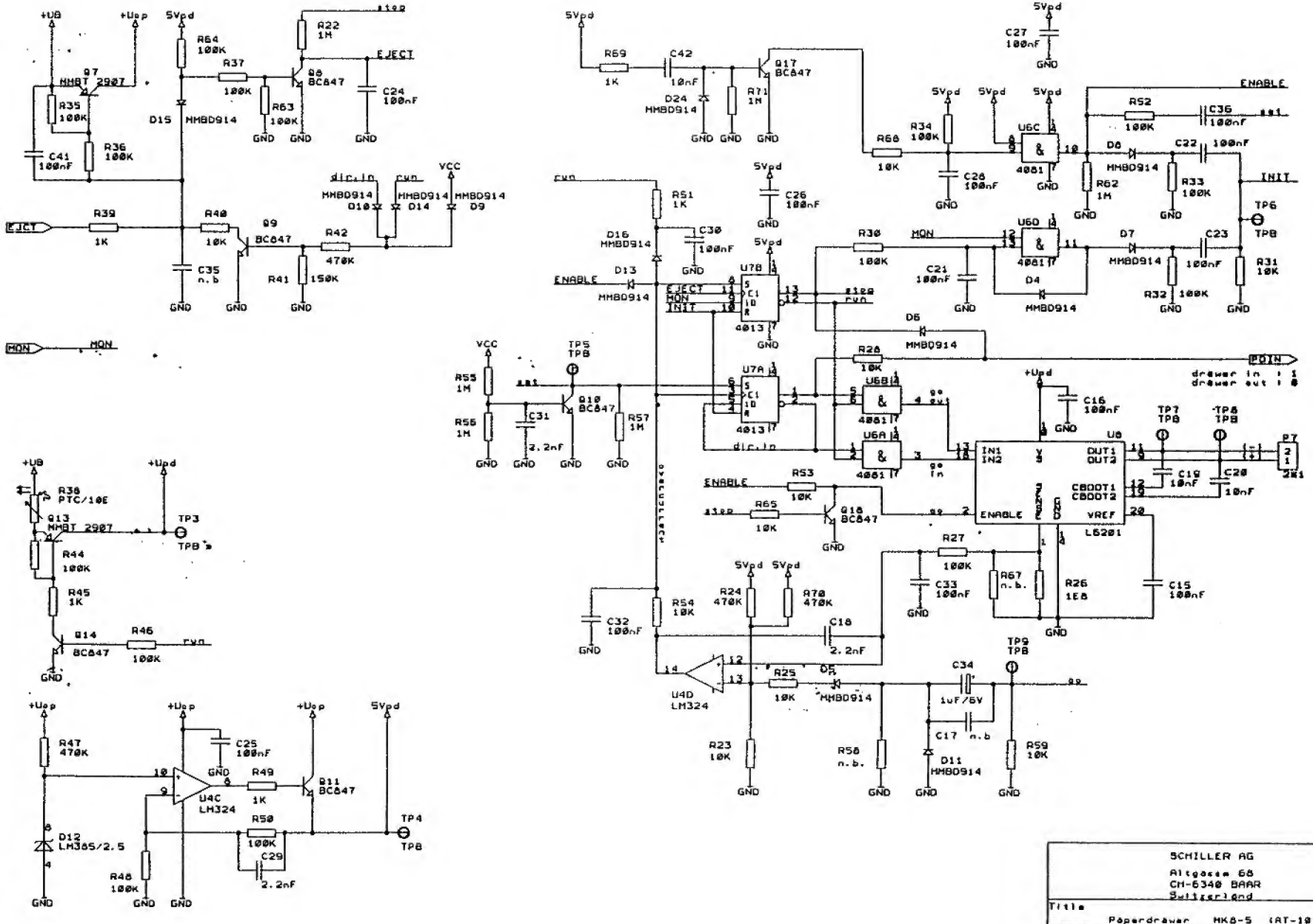

clock to phase conversion
VCC
+24VPR
U3A
U3B
U3C
U3D
4081
D2
D1
MMBD914
R4
PTC/10E
C4
68uF/6V
C5
100nF
C6
10uF/35V
C7
10uF/35V
GND
U2A
U2B
4013
TP10
TP11
TP12
TP13
TPB
R1
10K
P2
4x1
U1
TCA 3727-S0
TP14
TP15
R2
1E8
R3
1E8
C1
2.2nF
MCLK
(D=50%)
MON
R72
1K
C2
100nF
C3
100nF
SCHILLER AG
Altgasse 68
6340 Baar
Switzerland
Title
Stepper Motor - Driver MK8-S (AT-10)
Size
A
Document Number
S.2237DA
REV
Date: May 22, 1997
Sheet 2 of 5



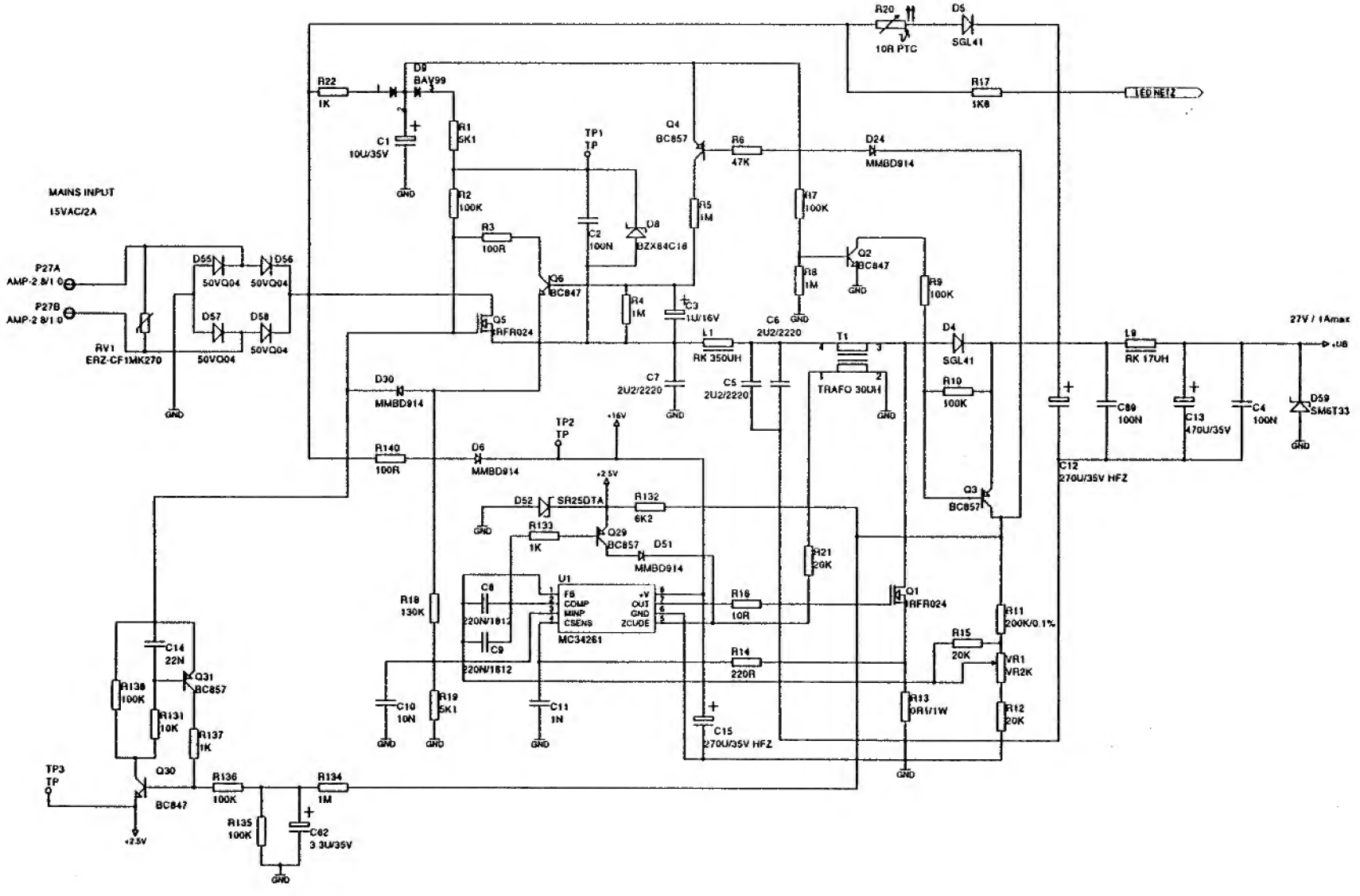
SCHILLER AG Altgasse 68 CH-6340 BAAR Switzerland		
Title: Papermark Detector MK8-S		
Size: A	Document Number: S.22370A	REV
Date: May 22, 1997	Sheet 3 of 5	



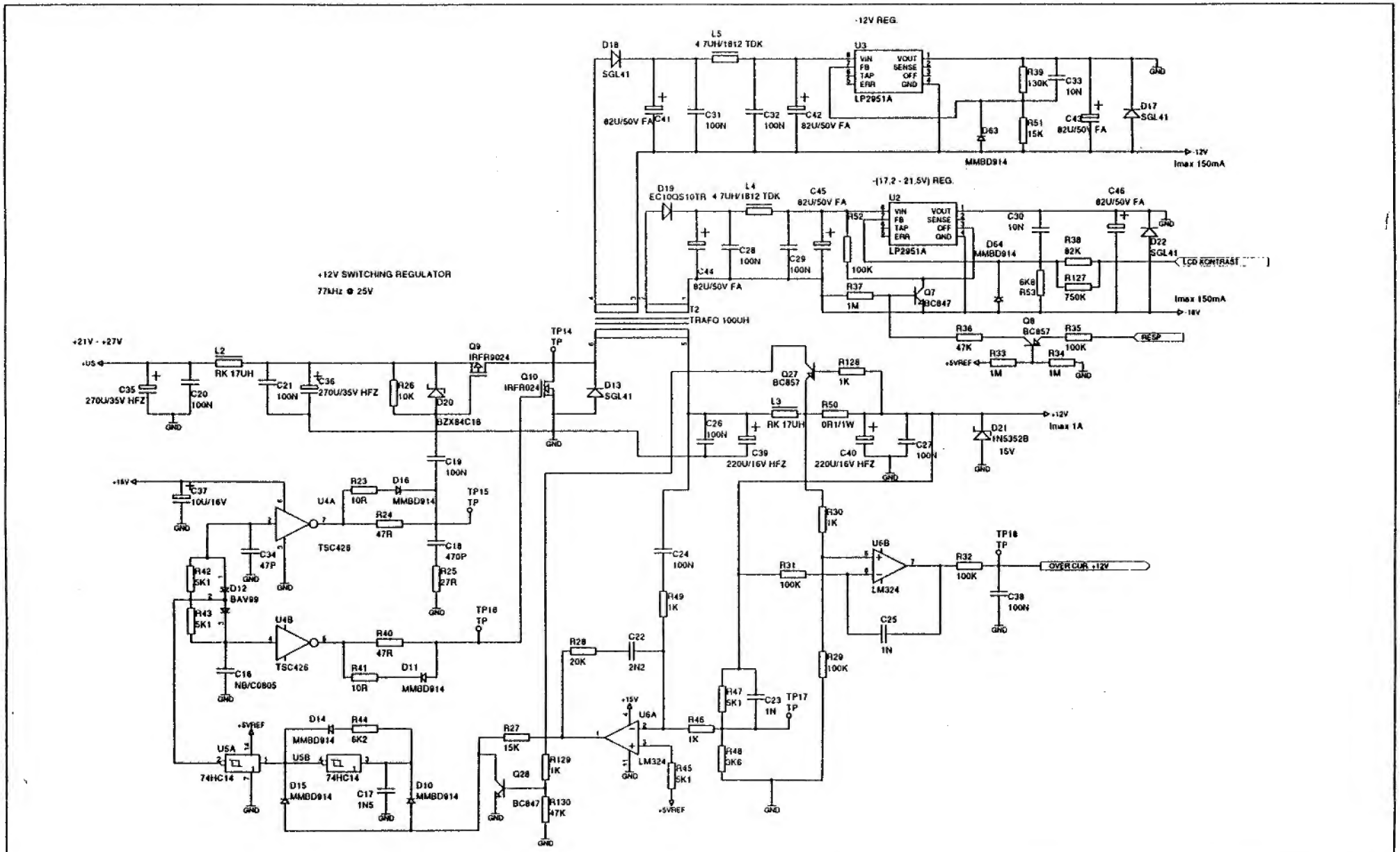
SCHILLER AG Altgasse 68 CH-6340 BAAR Switzerland		
Title Thermal Print Head - Driver MK8-S (AT-10)		
Size A	Document Number S.2237DA	REV
Date: May 22, 1997	Sheet of 5	



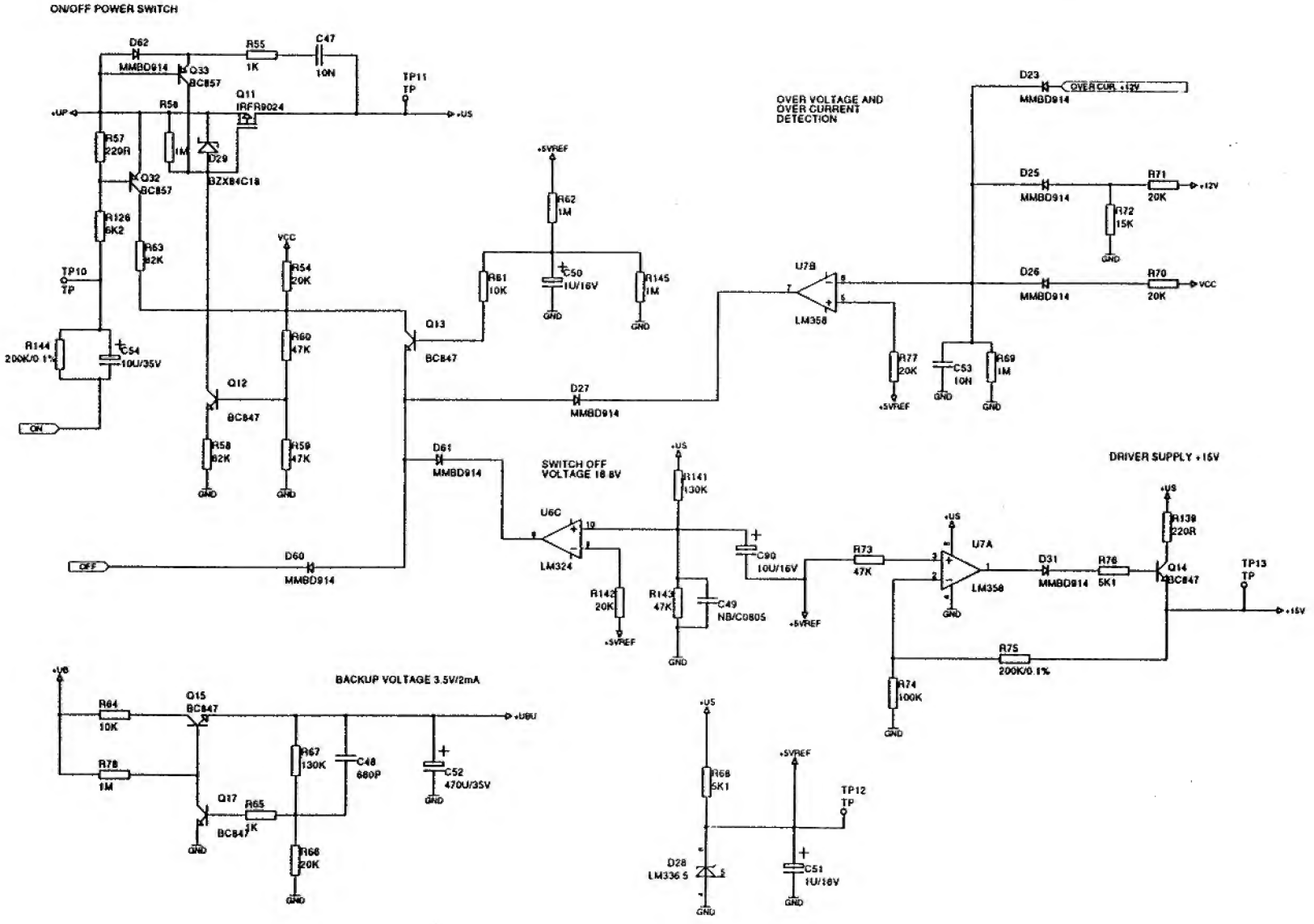
SCHILLER AG Altgasse 68 CH-6340 BAAR Switzerland		
Title: Paperdrawer MK8-5 (AT-10)		
Size: B	Document Number: S.22370A	REV:
Date: May 22, 1997	Sheet 5 of 6	

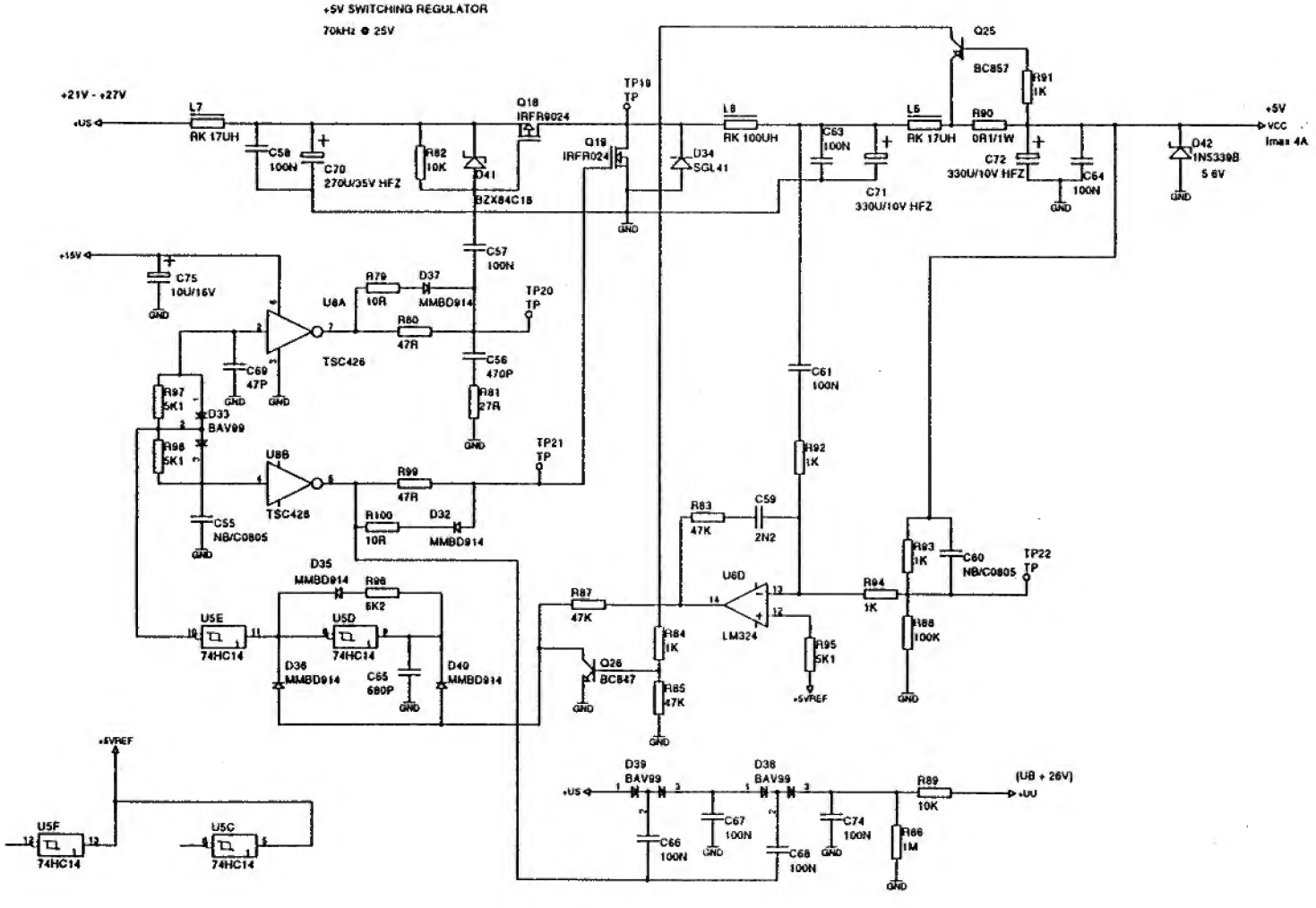


MAINS PFC-CONTROLLER MK8-6 (AT-10)				S.2238EF	Schiller AG Allgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: HSch	Date: 19.01.98	Sheet 2 of 6	

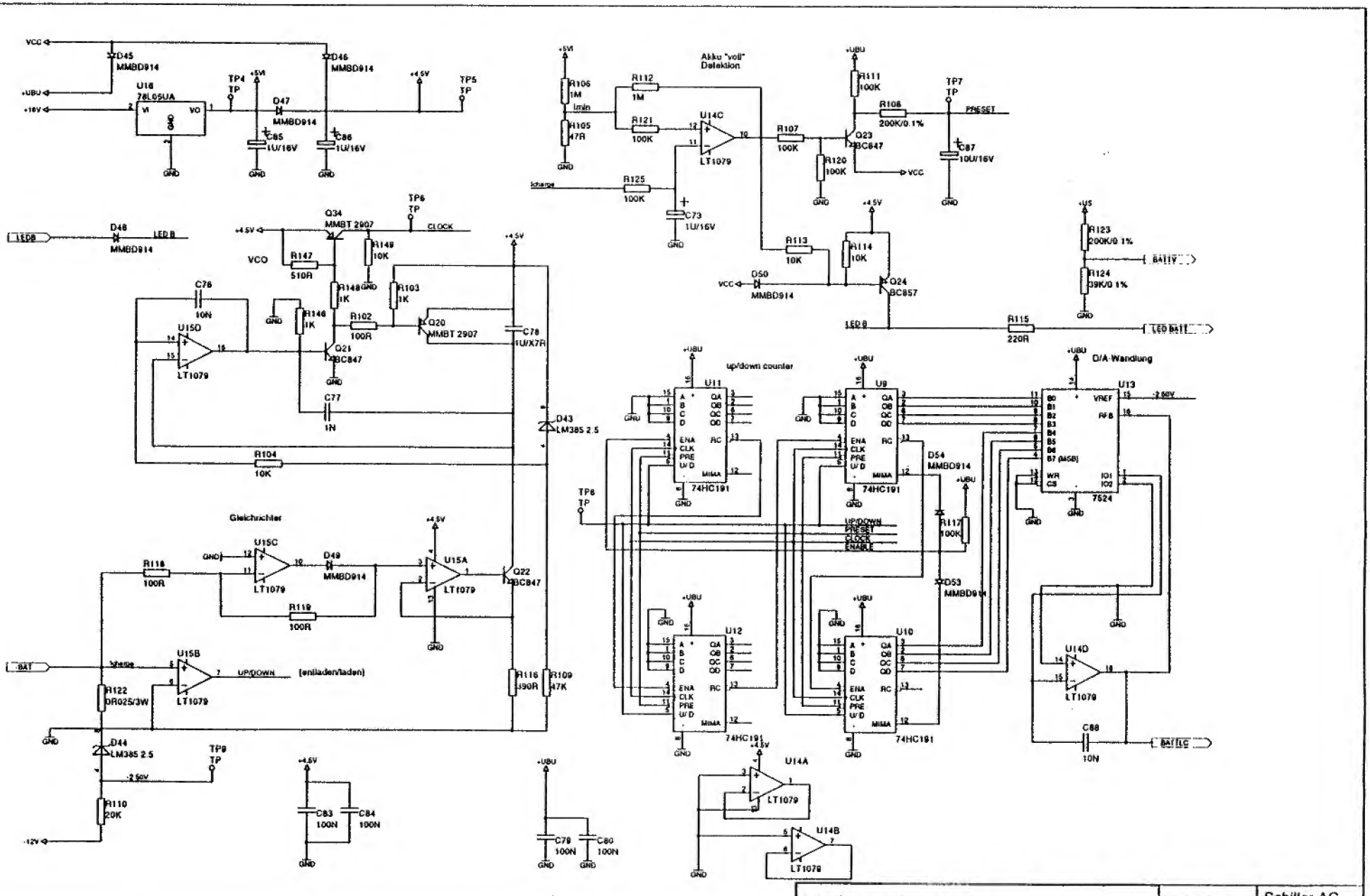


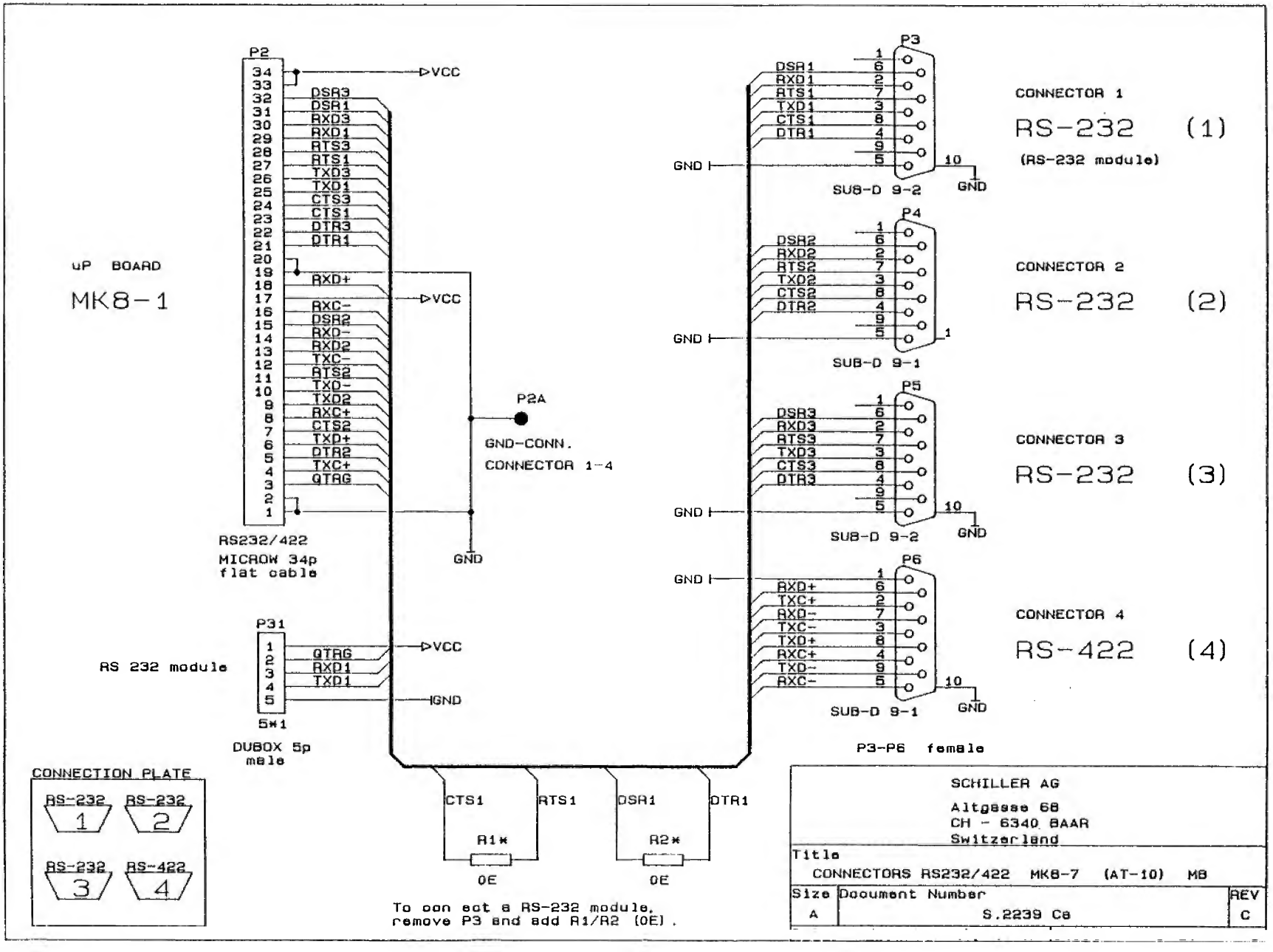
+12V/-12V/-18V SWITCHER MK8-6 (AT-10)				S.2238EF	Schiller AG Allgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: HSch	Date: 19.01.98	Sheet 3 of 6	

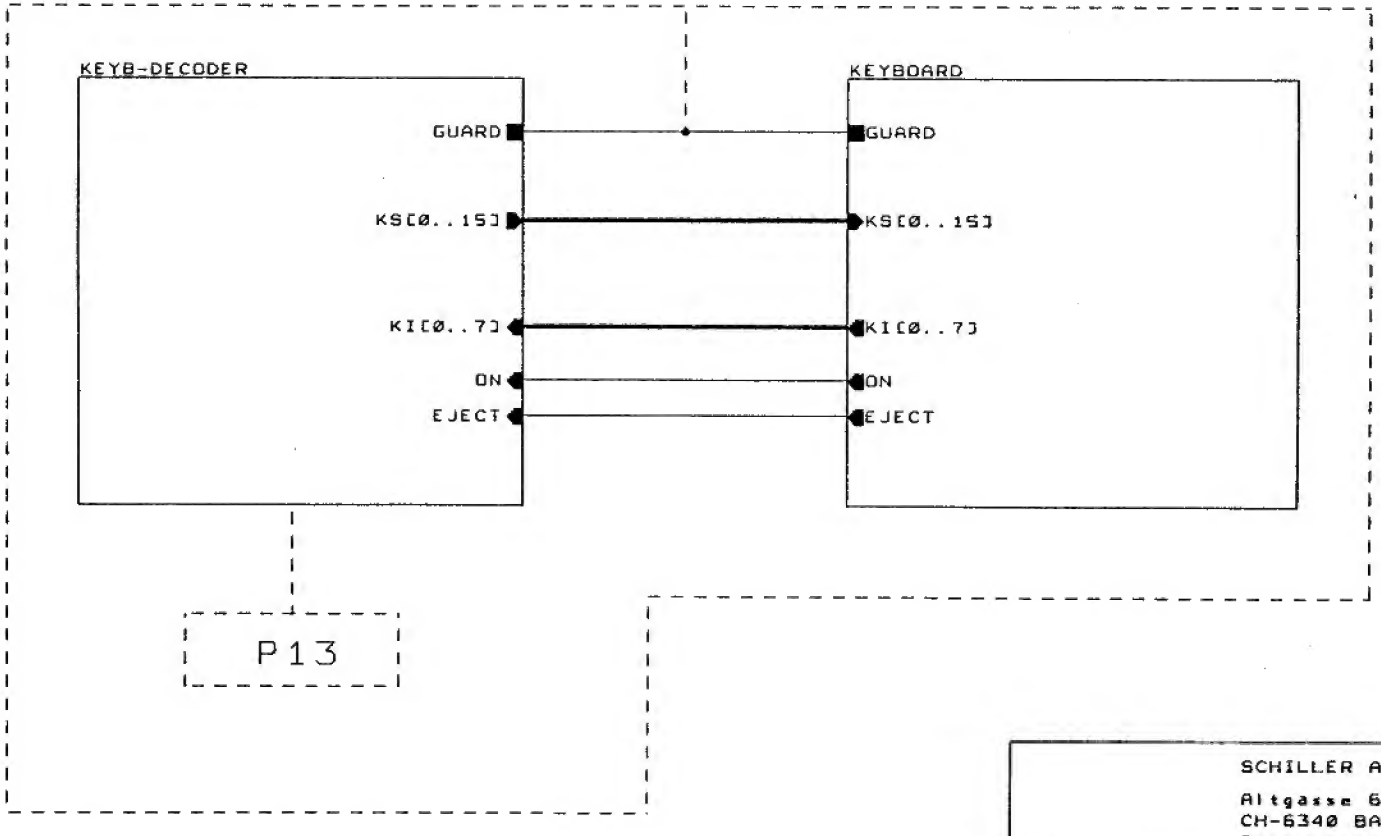

ON/OFF POWER SWITCH
D62
MMBD914
Q33
BC857
R55
1K
C47
10N
TP11
TP
+US
+UP
R58
Q11
IRFR9024
R57
220R
1M
D29
BZX84C18
Q32
BC857
R126
5K2
R63
82K
TP10
TP
R144
200K/0.1%
C54
10U/35V
ON
Q12
BC847
R58
82K
R60
47K
R59
47K
VCC
R54
20K
Q13
BC847
R61
10K
+5VREF
R62
1M
C50
10U/16V
R145
1M
GND
OVER VOLTAGE AND
OVER CURRENT
DETECTION
U7B
LM358
D23
OVER CUR. +12V
MMBD914
D25
MMBD914
R71
20K
+12V
R72
15K
D26
MMBD914
R70
20K
VCC
R77
20K
C53
10N
R69
1M
D27
MMBD914
D61
MMBD914
D60
MMBD914
OFF
SWITCH OFF
VOLTAGE 18.8V
U6C
LM324
R142
20K
R141
130K
R143
47K
C49
NB/C0805
C90
10U/16V
R73
47K
U7A
LM358
DRIVER SUPPLY +15V
D31
MMBD914
R76
5K1
Q14
BC847
R139
220R
TP13
TP
+15V
R75
200K/0.1%
R74
100K
BACKUP VOLTAGE 3.5V/2mA
+UB
R64
10K
Q15
BC847
+UBU
R78
1M
Q17
BC847
R65
1K
R67
130K
C48
680P
C52
470U/35V
R66
20K
R68
5K1
D28
LM336 5
TP12
TP
C51
1U/16V
ON/OFF BACKUP MK8-6 (AT-10)
S.2238EF
Schiller AG
Allgasse 68
CH-6340 Baar
Size: A3
Drawn by: STR
Entw: HSch
Date: 19.01.98
Sheet 4 of 6



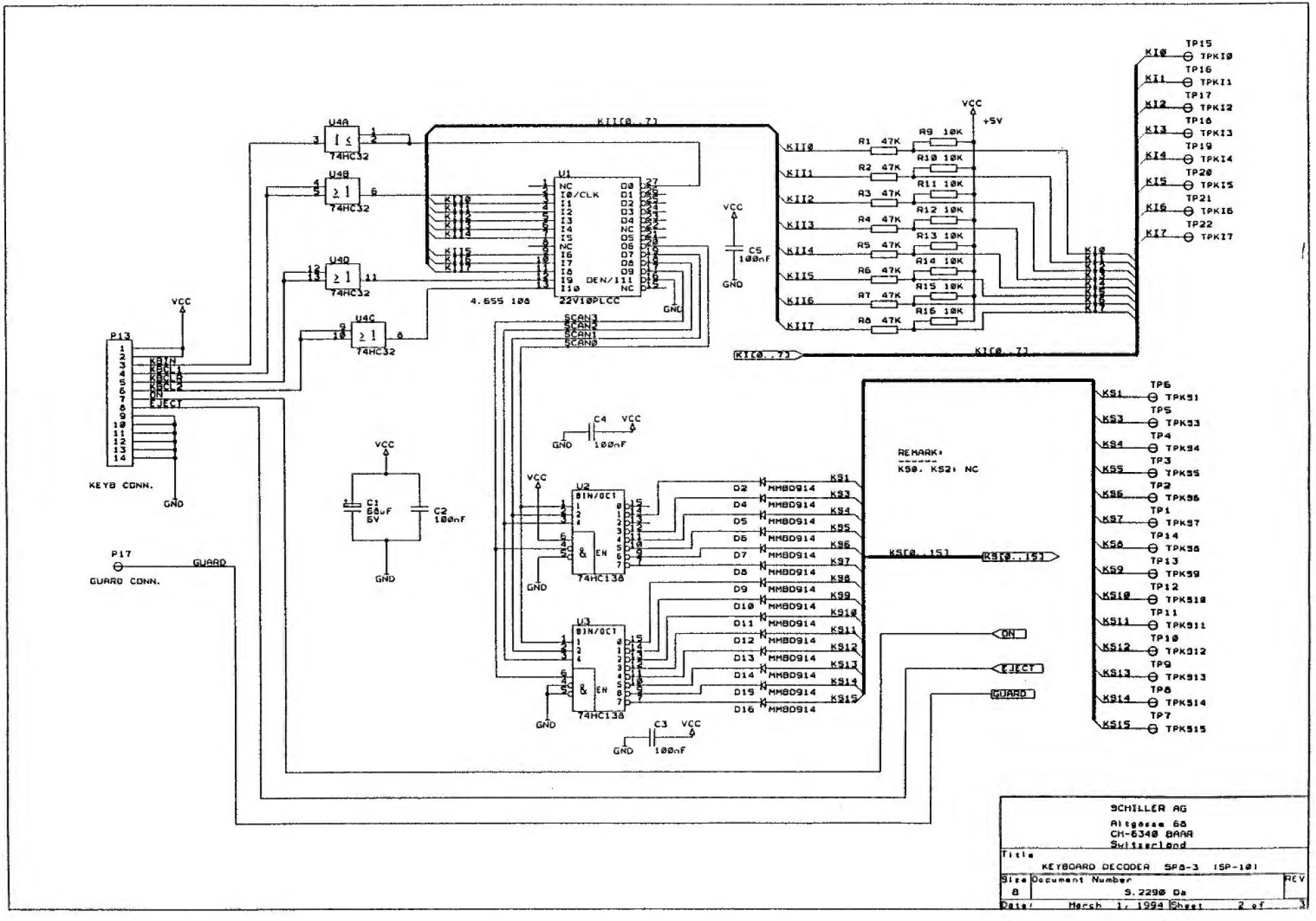
+5V SWITCHER MK8-6 (AT-10)				S.2238EF	Schiller AG Allgasse 68 CH-6340 Baar
Size: A3	Drawn by: STR	Entw: HSch	Date: 19.10.98	Sheet 5 of 6	

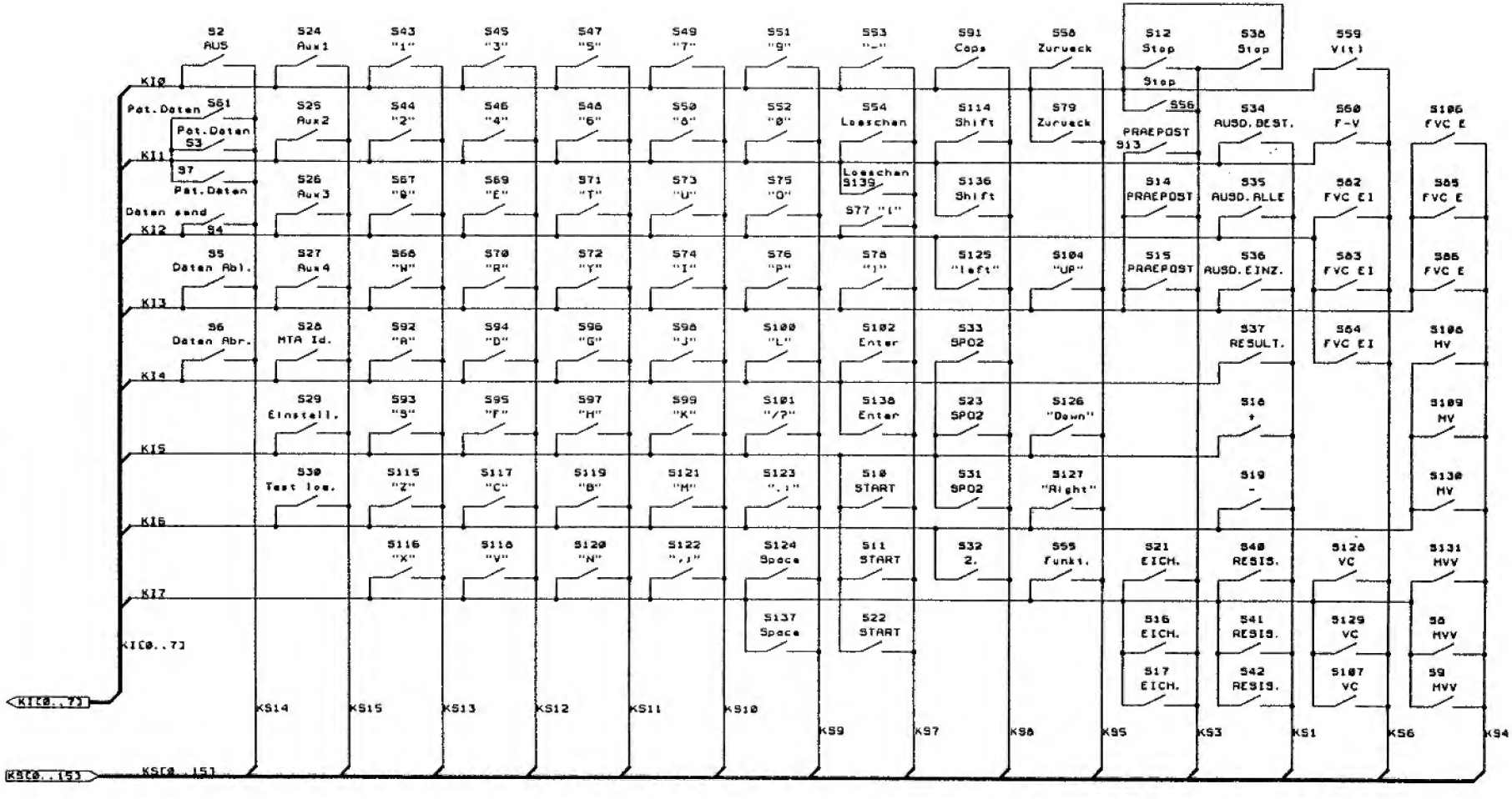

Akku "voll" Detektion
up/down counter
D/A-Wandlung
Gleichrichter
(entladen/laden)
Akku-Bilanz MK8-6 (AT-10)
S.2238EF
Schiller AG
Altgasse 68
CH-6340 Baar
Size: A3
Drawn by: STR
Entw: HSch
Date: 19.01.98
Sheet 6 of 6


uP BOARD
MK8-1
P2
34 VCC
33
32 DSR3
31 DSR1
30 RXD3
29 RXD1
28 RTS3
27 RTS1
26 TXD3
25 TXD1
24 CTS3
23 CTS1
22 DTR3
21 DTR1
20
19
18 RXD+
17 VCC
16 RXC-
15 DSR2
14 RXD-
13 RXD2
12 TXC-
11 RTS2
10 TXD-
9 TXD2
8 RXC+
7 CTS2
6 TXD+
5 DTR2
4 TXC+
3 QTRG
2
1
RS232/422
MICROW 34p
flat cable
P2A
GND-CONN.
CONNECTOR 1-4
GND
P31
1 QTRG
2 RXD1
3 TXD1
4
5 GND
VCC
5*1
DUBOX 5p
male
RS 232 module
P3
DSR1 1
RXD1 6
RTS1 2
TXD1 7
CTS1 3
DTR1 8
4
9
5 10
GND
SUB-D 9-2
GND
CONNECTOR 1
RS-232 (1)
(RS-232 module)
P4
DSR2 1
RXD2 6
RTS2 2
TXD2 7
CTS2 3
DTR2 8
4
9
5 1
GND
SUB-D 9-1
CONNECTOR 2
RS-232 (2)
P5
DSR3 1
RXD3 6
RTS3 2
TXD3 7
CTS3 3
DTR3 8
4
9
5 10
GND
SUB-D 9-2
GND
CONNECTOR 3
RS-232 (3)
P6
GND 1
RXD+ 6
TXC+ 2
RXD- 7
TXC- 3
TXD+ 8
RXC+ 4
TXD- 9
RXC- 5 10
SUB-D 9-1
GND
CONNECTOR 4
RS-422 (4)
P3-P6 female
CTS1
RTS1
DSR1
DTR1
R1*
R2*
0E
0E
To con eat a RS-232 module,
remove P3 and add R1/R2 (0E).
CONNECTION PLATE
RS-232 1
RS-232 2
RS-232 3
RS-422 4
SCHILLER AG
Altgasse 68
CH - 6340 BAAR
Switzerland
Title
CONNECTORS RS232/422 MK8-7 (AT-10) MB
Size A
Document Number S.2239 Ca
REV C

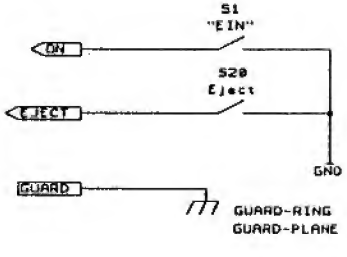


SCHILLER AG Altgasse 68 CH-6340 BAAR Switzerland		
Title: KEYBOARD SP8-3 (SP-10)		
Size: A	Document Number: 5.2290 Da	REV:
Date: March 1, 1994	Sheet 1 of 3	


U4A
74HC32
U4B
74HC32
U4D
74HC32
U4C
74HC32
U1
22V10PLCC
4.655 10Ø
KII[0..7]
VCC
+5V
GND
C5
100nF
R1 47K
R2 47K
R3 47K
R4 47K
R5 47K
R6 47K
R7 47K
R8 47K
R9 10K
R10 10K
R11 10K
R12 10K
R13 10K
R14 10K
R15 10K
R16 10K
KII0
KII1
KII2
KII3
KII4
KII5
KII6
KII7
KI0
KI1
KI2
KI3
KI4
KI5
KI6
KI7
TP15
TPKI0
TP16
TPKI1
TP17
TPKI2
TP18
TPKI3
TP19
TPKI4
TP20
TPKI5
TP21
TPKI6
TP22
TPKI7
SCAN3
SCAN2
SCAN1
SCAN0
P13
KEYB CONN.
KBIN
KEY1
KEY2
ON
EJECT
C1
68uF
5V
C2
100nF
C4
100nF
C3
100nF
U2
74HC138
U3
74HC138
BIN/OCT
EN
D2
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
MMBD914
KS1
KS3
KS4
KS5
KS6
KS7
KS8
KS9
KS10
KS11
KS12
KS13
KS14
KS15
KS[0..15]
KS[0..15]
REMARK:
KS0, KS2: NC
TP6
TPKS1
TP5
TPKS3
TP4
TPKS4
TP3
TPKS5
TP2
TPKS6
TP1
TPKS7
TP14
TPKS8
TP13
TPKS9
TP12
TPKS10
TP11
TPKS11
TP10
TPKS12
TP9
TPKS13
TP8
TPKS14
TP7
TPKS15
P17
GUARD CONN.
GUARD
ON
EJECT
GUARD
SCHILLER AG
Altgasse 68
CH-6340 BAAR
Switzerland
Title
KEYBOARD DECODER SPS-3 ISP-101
Size
B
Document Number
S.2290 Da
REV
Date: March 1, 1994 Sheet 2 of 3



KS0/KS2: NC



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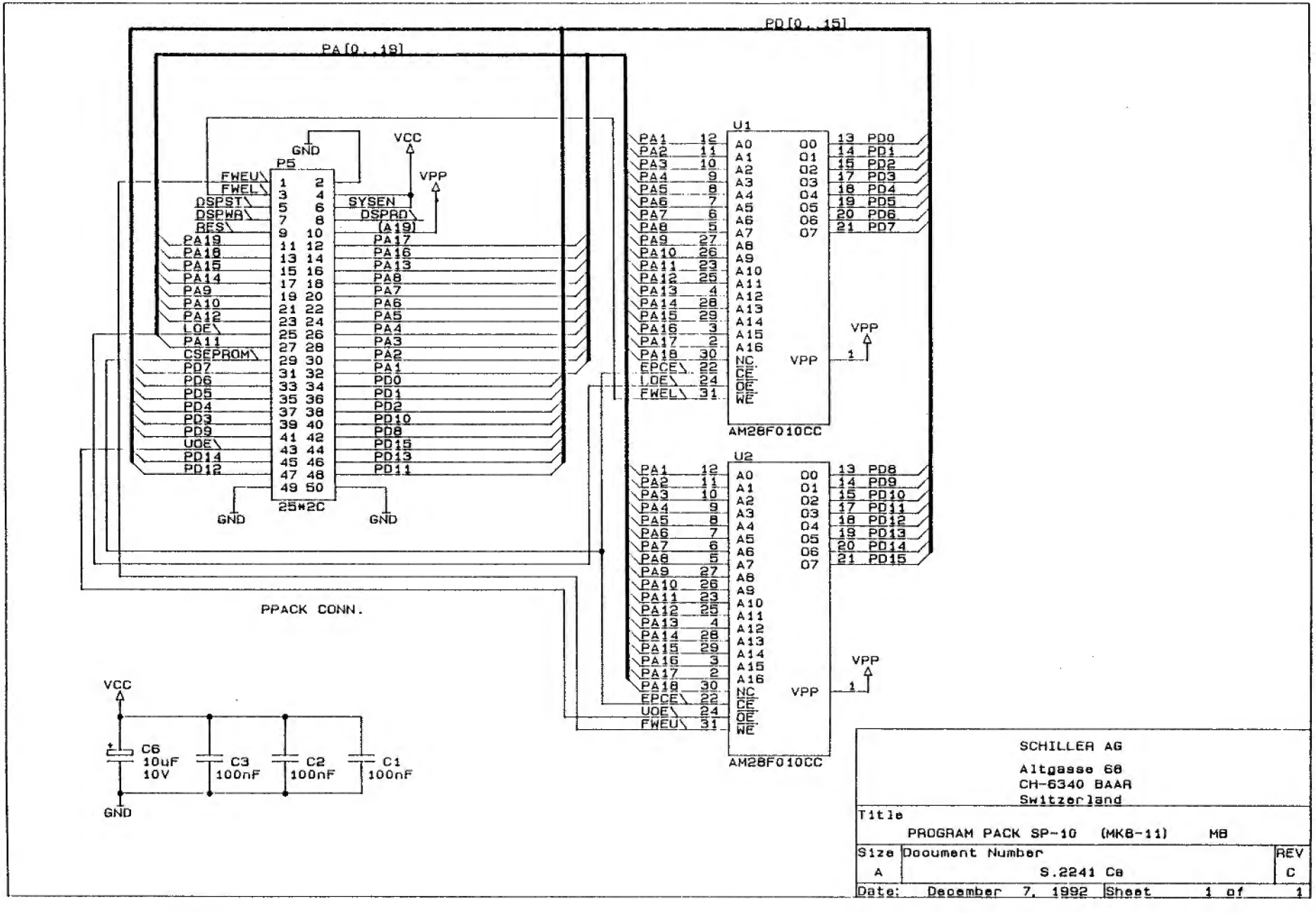
Title
KEYBOARD SP8-3 (SP-10)

Size	Document Number	REV
B	9.2290.0a	
Date: March 1, 1994	Sheet 3 of 3	


PD[0..15]
PA[0..18]
P5
GND
VCC
VPP
FWEU\
FWEL\
DSPST\
DSPWA\
RES\
SYSEN
DSPRD\
(A19)
PA19
PA18
PA15
PA14
PA9
PA10
PA12
LOE\
PA11
CSEPROM\
PD7
PD6
PD5
PD4
PD3
PD9
UOE\
PD14
PD12
PA17
PA16
PA13
PA8
PA7
PA6
PA5
PA4
PA3
PA2
PA1
PD0
PD1
PD2
PD10
PD8
PD15
PD13
PD11
25W2C
PPACK CONN.
U1
U2
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
NC.
CE
OE
WE
00
01
02
03
04
05
06
07
EPCE\
AM28F010CC
C6
10uF
10V
C3
100nF
C2
100nF
C1
100nF
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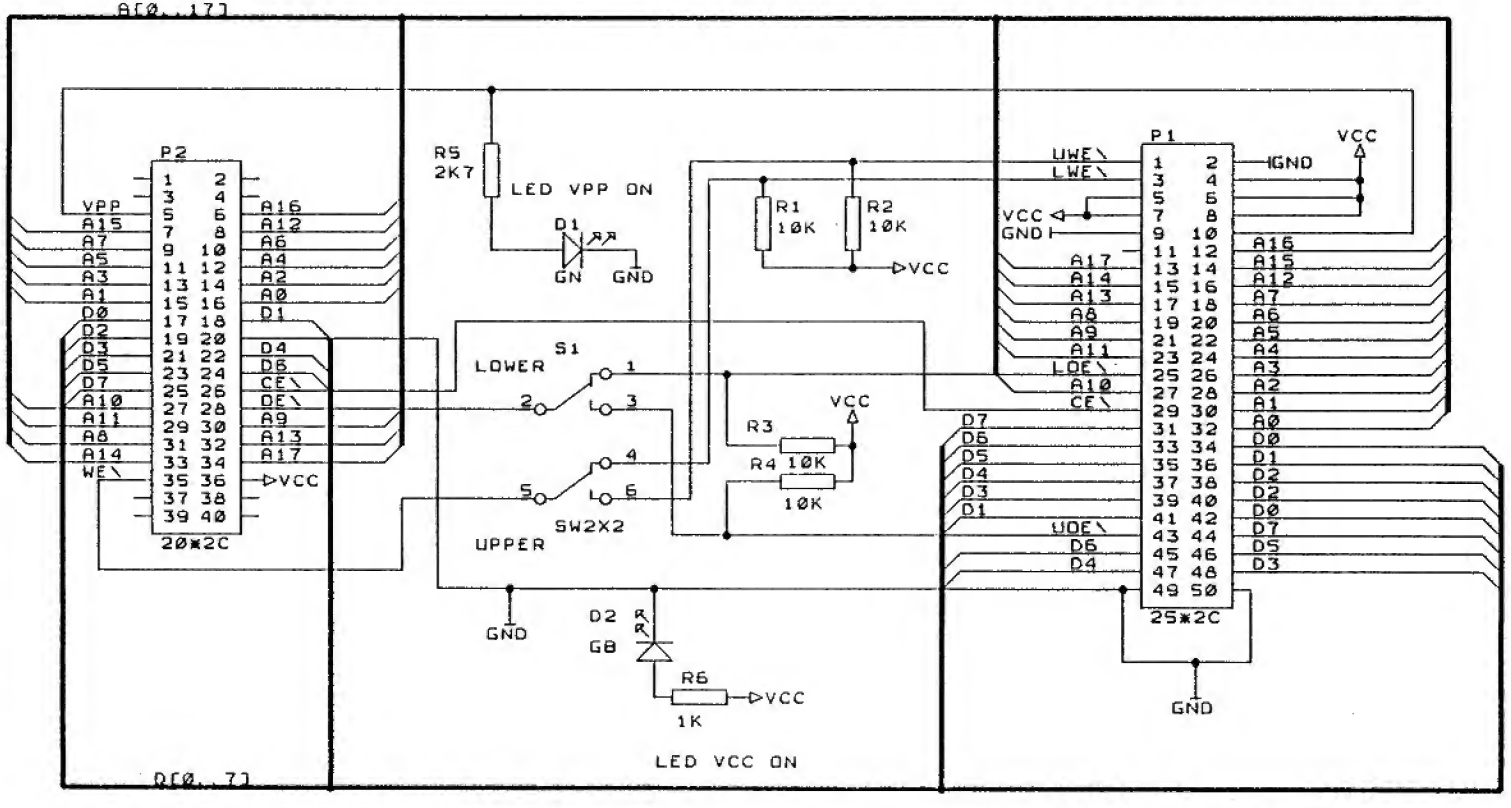
Switzerland
Title
PROGRAM PACK SP-10 (MK8-11) MB
Size
A
Document Number
S.2241 Ce
REV
C
Date: December 7, 1992
Sheet 1 of 1

PROGRAMMER

PPACK MK8-11



SCHILLER AG Altgase 6A CH-6340 BAAR Switzerland		
Title: PROGRAMMER-ADAPTER AT-10 / SP-10 MB		
Size: A	Document Number	REV: B
Date: December 30, 1992	Sheet 1 of 1	